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THE EFFECT UPON FUEL ECONOMY OF DIFFERENT ARRANGEMENTS OF BAFFLES IN BOILER TUBES

By LIEUT. WILLIAM G. EAGER,[1] PHILADELPHIA, PA.

WHEN it is considered that the cost of fuel is invariably from forty to sixty per cent of the operating cost of producing power and that even in a small plant this cost runs to many thousand dollars a year, it is surprising that so little time is given by operators to investigating the effect upon fuel economy and boiler capacity of varying the paths of the gases between the combustion chamber and the uptake.

Considerable thought seems to be given to the design of the boiler shell, tubes and accessories to make them more nearly perfect theoretically and mechanically. An arbitrary relation is taken between heating surface and grate area based upon years of experience, and much ingenuity is used in the development and application of different types of mechanical stokers and other labor-saving appliances. There seems to be, however, among some boiler makers and operators an indifference in the matter of investigating the actual results obtained by varying the location of the baffles in the banks of boiler tubes.

Upon this phase of boiler practice depends to no small extent the ultimate economy of the boiler. If the gases pass through the banks of tubes in too direct a course, they carry with them up the stack an unnecessary amount of valuable heat. On the other hand, if the arrangement of baffles in the tubes is such as to restrict unduly the passage of the gases, the boiler may evaporate water economically but it will not readily respond to unusual demands on its capacity.

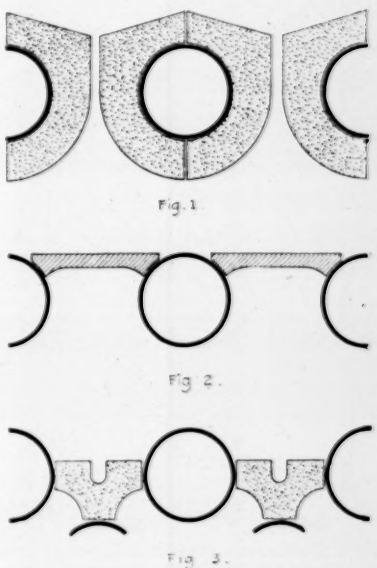
Again, the baffles may be so arranged as to form pockets of inactive gases, which are excellent non-conductors and which will tend to cut down the effective heating area. This would lower both the efficiency and capacity of the boiler.

Object of Tests

With these facts in view, a series of tests was made upon three similar boilers of the Heine type to determine the arrangement of baffles for this type of boiler which would give the best evaporation in pounds of water from and at 212 deg. fahr. per pound of coal, and at the same time meet the requirements of full capacity and a moderate superheat temperature.

These tests were made under commercial operating conditions at the combination ice and electric plant of the Valdosta (Ga.) Lighting Company and extended over a period of six and one-half weeks, beginning March 10, 1913. No records of previous investigations along this definite line and no references dealing with this specific phase of boiler practice were available. While it was not possible to introduce such refinements as are obtained in laboratory work, it is believed that the tests conducted under these normal and fairly uniform operating conditions have satisfactorily brought out the valuable features of the matter under investigation. The questions of the effect of baffling on draft, combustion, circulation and scale forming are of interest and importance, but these are problems which could each be made the major subject of an extended investigation. It is not intended in this discussion to attempt to differentiate between the effects produced by each of these factors, but to accept the effects as a whole as reflected in the final results.

Had a CO_2 recorder been available these records would prove of value and importance in that they would indicate what degree of uniformity of combustion was obtained in the various cases. Such an instrument, however, was not at hand, and, with a view to obtaining a comparison which would indicate any wide variation in the method of firing, tests were conducted on each of the three boilers, using the two arrangements of baffles which showed best results.



FIGS. 1-3 TYPES OF BAFFLE TILE USED IN BOILER TESTS

NOTE.—Tile in Fig. 3 falls away from tubes at top and closes passage between tubes.

Principles and Methods Employed in the Investigation

The problem involved in this work was fundamentally the choosing of that location of the baffles which would enable the heating surface of the boiler to extract the greatest amount of heat from the coal burned without impairing the capacity of the boiler, and this brought up for consideration several important points and principles. First of all, an encircling tile shown in Fig. 1 was used on the lower bank of tubes. This baffle remained the same in each test, and it is interesting to note that it offered a hot surface against which the unburned gases might impinge, thus burning the volatile matter and carbon particles more completely than as if they had been allowed to strike the cold surface of the tubes. Secondly, this encircling tile saved the lower banks of tubes by protecting them from wide and sudden temperature variations and the intense heat over the bridge wall.

The orifice between these baffles on the lower bank of tubes and the back water leg must be large enough not to restrict the flow of the gases and yet close enough to the rear water leg to force the gases well back in order to take full advantage of the large heating area of these tubes, which would be lost if the gases were cut off too soon. The middle course of baffles, where one is used, must be placed with this latter thought in

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Abstract of a paper presented at a meeting of the Atlanta Section of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS, April 9, 1918.

mind, and in addition it must be remembered that the falling temperature of these gases at practically constant pressure gives a corresponding reduction in volume, and for this reason this course of baffles should be pushed nearer to the front water leg than the lower baffle is to the rear water leg. This type of baffle is shown in Fig. 2. If the split baffle is used, that is, if the baffle does not extend to either water leg, it should be installed in such a way as to split evenly the gases, as the heating surfaces either way are practically the same. Moreover, equal care must be taken not to obstruct the gases here.

Another item to be considered in connection with this baffle is that its position will affect the temperature of superheated steam to a considerable extent, as will be shown. The principles regarding the reduction in volumes and the undue restriction of gases also apply to the top course of baffles. This type is shown in Fig. 3. It must be borne in mind that the heating area under the drums is much less than that available in the banks of tubes above the middle baffle, and also that if the gases are permitted to do so, they will rise under the drums

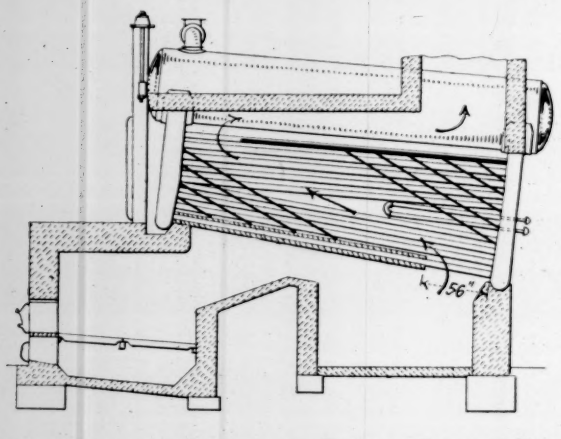

FIG. 4 LOCATION OF BAFFLES AND PATH OF GASES IN BOILER, CASE *A*

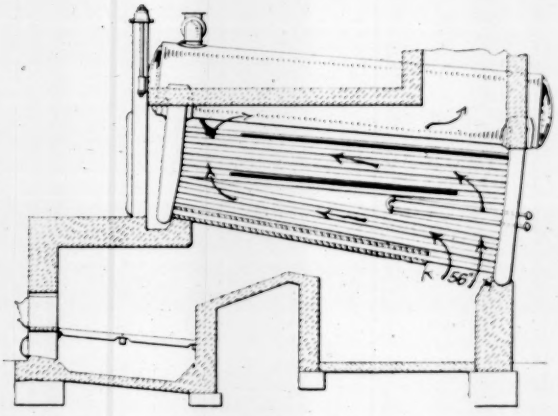

FIG. 5 LOCATION OF BAFFLES AND PATH OF GASES IN BOILER, CASE *B*

and move along it to the uptake. If these gases are therefore to be split at this point, they should be divided roughly in the ratio of the effective heating area under the drums and that available in the tubes. In this connection, however, it is well to note that the gases in the banks of tubes will tend to creep along the top banks to some extent, and that these banks will consequently do more than their share of the work. Care must also be taken in the placing of baffles to see that they are not so located as to prevent the proper blowing of the soot from around the tubes.

It is of the greatest importance that all air leaks be stopped and that the stack damper be always in good operating shape and intelligently used. No matter what form of baffling is used, it is absolutely necessary, from the standpoint of economy, that there be no holes or missing baffles in any course. Such a condition will cause the gases to short-circuit, and will be indicated by decreased evaporation per pound of coal and higher stack temperature.

All these tests were carried out according to the code of The American Society of Mechanical Engineers. The alternate method of starting and stopping was used. Each test was from 58 to 120 hours' duration. Observations were made hourly. With the boilers cold, readings were taken on the gage glass and the water meter simultaneously as the boiler was filled to determine the volume of water admitted for each fraction of an inch on the gage glass. This was done to determine the amount of water blown off. The coal used was Crane Creek No. 1, run of mine, from Colmar, Kentucky. It was dumped in one large pile and was taken from different points in this pile as required. The term "combustible" is used to designate coal dry and free from ash and refuse. This was determined by deducting from the coal as weighed the percentage by weight of moisture, found by drying it artificially, plus the weight of ashes and refuse taken from the ashpits. The feedwater was treated with soda ash and tri-sodic phosphate before reaching boilers, and was fed as uniformly as possible under the varying operating conditions. Water was weighed at average feedwater temperatures.

A thin, fast fire was invariably carried, and the load, which consisted of steam turbines used for generating electricity and an engine driving an ammonia compressor, was quite variable at different times of the day and night, due to the variation of the electric load and the occasional shutting down of the ice machine. To bring out clearly the extent of this variation, figures have been compiled which indicate the ratio of the average boiler horsepower developed during the whole test and the average horsepower developed over the hourly period during which the total output for the hour was a maximum.

DESCRIPTION OF BOILERS

The tests were made upon three similar boilers of the Heine return tubular type, made by the Casey Hedges Company. They had a heating area of 5000 sq. ft. and a grate area of 86¾ sq. ft., giving a ratio of 56 to 1 between heating surface and grate area. The rated horsepower was 500. The boilers were equipped with Dutch ovens and were hand-fired. No. 1 had been in use but a few weeks, while No. 2 and No. 3 had been in service for about a year. No. 3 was equipped with Thomas elliptic grate bars, and Nos. 1 and 2 with the ordinary type of herringbone bars. The boilers were all equipped with Foster superheaters and Bayer soot blowers, and were thoroughly cleaned before beginning the tests. No. 1 was not insulated. The other two had a covering of 1½ in. of asbestos cement over settings and drums.

The apparatus used consisted of Howe scales, a Worthington turbine feedwater meter of the hot-water type, a Bristol recording steam gage, indicating gages, stack pyrometer and thermometers in feedwater line and steam lines. All instruments were checked and calibrated.

ARRANGEMENT OF BAFFLES

Four different arrangements of baffles were used which are designated as cases *A*, *B*, *C* and *D*, shown in Figs. 4, 5, 6 and 7, respectively. Case *A* indicates the maker's arrangement of baffles in boilers Nos. 2 and 3. This consisted of a set of encircling tile (see Fig. 1 for detail of tile) around the lower course of tubes extending from the front water leg to within 56 in. of the back water leg and a set of special V-tile (see Fig. 3) resting upon the top course of tubes and extending from the rear water leg to within 42 in. of the front water leg.

The course of the gases would therefore be from the lower corner at back of boiler upward, then under the drums and out. Fig. 4 shows the arrangement of baffles and the course of these gases. Low evaporation per pound of coal indicated that the gases were passing through the banks of tubes too quickly, and an observation of the condition of the tubes led to the belief that the shaded area in Fig. 4 was in a practically inactive state.

The indications were that dead-air pockets were formed at these places. which were quite effectually preventing these parts of the tubes from getting their proportion of the heat and, therefore, from doing their proportion of the work. With a view to modifying this in such a way as to overcome this fault, and to distribute the heat more evenly over the whole length of the tubes, a split baffle was used over the lower course of the top section of tubes. This method is called Case *B* and is indicated in Fig. 5. The baffle in this case was of cast-iron tile and rested upon adjoining tubes. (See Fig. 2 for section of baffles.) The baffles were placed from within 40 in. of the front water leg to within 40 in. of the rear water leg. As far as the volume of gases at this point is concerned, this baffle could well have been extended closer to each water leg, but it was thought best on account of the position of the superheater in one path and the sudden change of direction of gases in the other path to locate it in this way. It was expected that an increase in the temperature of the superheated steam would result from this method because it permitted a part of the gases to pass through the whole of the superheater instead of merely crossing one end of it.

Fig. 6 indicates the maker's arrangement of baffles in boiler No. 1, which was new when tested. This is designated as Case *C*. It will be noted that the lower baffle is the same as in previous cases, that the middle baffle is moved 48 in. from the front water leg and is extended entirely to the rear water leg, and that the top baffle is split and extended to within 42 in. of each water leg, with a vertical wall around the drums and midway the baffle, which forces the gases after striking the drums to return and pass through the upper banks of tubes and then out. It was found that this arrangement reduced the capacity of the boiler so as to cause a failure of steam over the peak load. There was apparently no reason for this unless it was that an eddy or swirl was set up at *E* (see Fig. 6), due to the gases returning to the tubes after striking the drum. Such a swirl would, no doubt, seriously obstruct the passage of gases at this point, and there seems no other logical reason for the behavior of this boiler.

Case *D*, shown in Fig. 7, is a modification of this arrangement with a view to overcoming the difficulty apparently arising from this cause. With the lower and middle baffles the same as in Case *C*, the top baffle is continued to within 8 in. of the front water leg and the vertical wall around the drums is removed. This, it will be seen, causes the gases to divide, the main portion of them passing through the tubes and the smaller portion through the 8-in. orifice, under the drums and out.

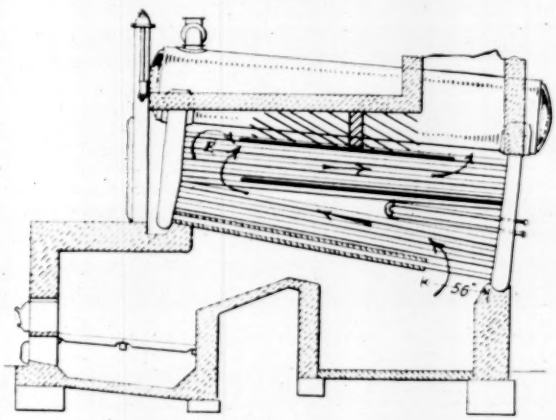

FIG. 6 LOCATION OF BAFFLES AND PATH OF GASES IN BOILER, CASE *C*

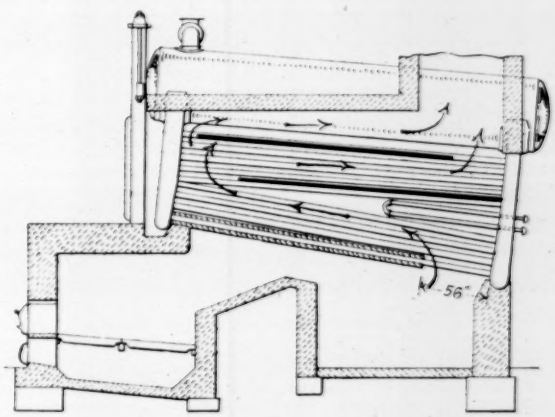

FIG. 7 LOCATION OF BAFFLES AND PATH OF GASES IN BOILER, CASE *D*

CONDUCT OF TESTS

It was the original plan to have each test cover a period of 120 hours, and the first one was carried over this period. The second was begun with this idea in view, but because of the development of weakness in one of the tubes this test was closed at the end of 58 hours. On account of operating difficulties, it was decided to make the remaining tests of 58 hours' duration. Such important observations as weights of coal and water were checked and a record of all unusual conditions was kept in the daily log sheet. Each test was computed as soon as it was finished, and the data thus obtained were used in determining the arrangement of baffles in the next test and the desirability of checking that method on the other boilers. The principles and details of the method have been fully described. The indicating steam gages were checked against the recording gage from time to time. Care was taken to avoid inequalities in the coal, which was taken from different points in a large pile in rotation. Unusual care was taken in the starting and stopping of tests to see that the test conditions were satisfied.

The *A* test was not run on boiler No. 1 because the evaporation obtained in the *B* test on the other boilers was obviously better and because the results obtained from boilers Nos. 2 and 3 were in line when the relative horsepower developed and the

varying conditions were taken into consideration. The *C* test was not run on boilers Nos. 2 and 3 because the test on boiler No. 1 indicated that this arrangement of baffles would not be satisfactory from the operating standpoint on account of the cutting down of capacity. The choice seemed to lie between the *B* and *D* methods of baffling, and these tests were respectively made on each boiler.

COMPUTATIONS AND RESULTS

As the calculations are of minor importance and are not out of the ordinary, only an outline of the method followed will be given. A five-place table of factors of evaporation for different pressures and temperatures of feedwater, corrected in each instance for superheat, was compiled from the seventh edition of Peabody's Tables, and used to determine the equivalent evaporation from and at 212 deg. The figures for weight of water at various temperatures were determined by weighing the water at these temperatures. The results of the calculations are given in Table 1.

load conditions of a central station are varying, and that a fireman who is accustomed to the way the load comes on during the day is at a disadvantage on the night turn until he becomes accustomed to the load as it comes on during the shift. Care was taken to avoid these variations as far as possible, but because of their occurrence tests were conducted upon three boilers instead of upon one only. The results appear logical with few exceptions.

Test under case *A* on boiler No. 3 showed a much lower evaporation than the corresponding test on boiler No. 2. This was no doubt due to the lower average horsepower developed by boiler No. 3, which was only 342, as against 519 for boiler No. 2. All the tests on boiler No. 1 appeared abnormally low for a new, clean boiler, and this was probably due to the fact that while both the other boilers were well protected with asbestos covering, the drums and the setting of boiler No. 1 were exposed. Boiler No. 3 was the only one that did not show a decided advantage in evaporation for the *D* arrangement of baffles over the *B* arrangement. It will be noted, however, that the average horsepower developed in the *B* test was 535

TABLE 1 DATA OBTAINED IN BOILER TESTS

	A Test		*B* Test			*C* Test	*D* Test		
	Boiler No. 2	Boiler No. 3	Boiler No. 1	Boiler No. 2	Boiler No. 3	Boiler No. 1	Boiler No. 1	Boiler No. 2	Boiler No. 3
Date of test (1913)	Mar. 17	Mar. 10	Apr. 17	Apr. 21	Mar. 31	Mar. 24	Apr. 10	Apr. 14	Apr. 7
Duration of test, hours	58	120	58	58	58	58	58	58	58
Actual evaporation per lb. of coal as weighed, lb. Water not corrected for superheat	8.95	8.38	8.39	9.36	9.49	9.63	9.50	9.61	9.63
(*a*) Equivalent evaporation from and at 212 deg fahr. per lb. of coal as weighed, lb	10.06	9.37	9.61	10.46	10.64	10.55	10.51	10.85	10.68
(*b*) Per cent of combustible in coal	89.2	88.5	89.6	88.2	90.1	89.2	89.0	89.0	89.6
Equivalent evaporation per lb. of combustible [= Item (*a*) × 100 ÷ Item (*b*)], lb	11.28	10.58	10.73	11.86	11.81	11.82	11.81	12.19	11.92
(*c*) Average horsepower developed during full period of test	519	342	458	482	535	542	448	463	519
Per cent of rated horsepower	104	68	92	96	107	108	90	93	104
Load factor [= ratio between average horsepower (*c*) and maximum horsepower developed for any 1 hr. of test; relation arbitrarily assumed for purpose of indicating variation in load on boiler]	0.55	0.50	0.69	0.63	0.69	0.71	0.62	0.62	0.69
Average temperature of gases in stack during test, deg. fahr	486	586	612	542	617	541	568	527	613
Average temperature of feedwater at intake, deg. fahr	187.8	189.3	195.5	204.0	189.1	197.2	184.7	187.5	196.6
Average temperature of steam leaving superheater during test, deg. fahr	462.7	439.4	493.9	469.9	448.5	418.7	413.9	459.0	438.8
Average steam pressure in boiler during test, lb. per sq in. gage	156	153	155	155	157	156	158	157	159

ACCURACY OF TESTS, METHODS AND RESULTS

While the instruments used were calibrated and checked, it would have made very little difference as far as the comparative value of the baffling was concerned as long as the same variation occurred in each test. The greatest inaccuracy which was likely to occur was in starting and stopping, and in this unusual care was taken. As 58 hours was the shortest period of any test, such an inaccuracy would be minimized in the final result, and it is safe to assume that the variation due to this cause alone would not have amounted to over one-half of one per cent.

It would appear that the personal equation in firing of boilers would be the most likely source of comparative variation. A fireman's physical condition will affect his firing, and a change of men might account for a rather wide variation. It has been observed that a remarkable increase in coal consumption is to be noted when firemen change from the day to the night shift, and vice versa. This is due to the fact that the

as against 519 in the *D* test, so that the gain, while less than in the other cases, is more marked than a glance at the figures would indicate. In the other two cases, although the horsepower developed in the *B* test was higher than in the *D* test and better economy would be expected on account of the increased horsepower, the *D* arrangement of baffles shows to advantage in economy.

DISCUSSION OF RESULTS

Fig. 8 indicates graphically the results obtained in equivalent evaporation from and at 212 deg. per pound of coal and per pound of combustible in tests *A*, *B* and *D*. Case *C* is not plotted as this was run only on boiler No. 1, because with this arrangement of baffles No. 1 developed a weakness in overload capacity and, while the average horsepower developed was high, it was unable to carry the peak load. The objections are, first, an apparent interference with the passage of the gases

at *E*, Fig. 6, due to the gases returning upon themselves, and, secondly, an area heated only by convection, which for all practical purposes may be considered a dead area, between the top baffle and the drum and indicated by the shaded area in Fig. 6.

The full lines in Fig. 8 indicate the equivalent evaporation in pounds of water from and at 212 deg. per pound of coal, and the dotted lines the equivalent evaporation per pound of combustible. An interesting feature in connection with these curves is that the full-line curve of boiler No. 3 crosses that of No. 2 twice, whereas when the available combustible matter, which varies with the quality and firing of the coal, is taken into consideration, as indicated by the dotted lines, all three points of No. 3 fall below the corresponding points of No. 2.

There is a noticeable improvement in case *B* over case *A* and case *D* over case *B* in each instance. The low point No. 3 reaches in case *A* is without doubt due to the low horsepower developed and the wide variation in load. The horsepower was 342 against 535 for the *B* test and 519 for the *D* test. That is, while the average horsepower developed during tests *B* and *D* was slightly in excess of the boiler rating, it was in the *A* test 33.6 per cent under the rated capacity. The load factor, as this term is defined in Table 1, was 0.50 as against 0.69 in each of the other tests on this boiler. The low evaporation in the *B* and *D* tests on boiler No. 1 can probably be practically accounted for when it is noted that this was the only boiler not covered with asbestos.

The low evaporation obtained in the *B* test on this boiler, together with the high stack temperature and the unusually high superheat temperature, seem to be due to a partial short-circuit in the top baffle (see Fig. 5) near the rear water leg. This baffle was not put in permanently, and the poor fit of the baffle tile at the rear water leg would cause the gases to rush through the superheater and part of them directly up the stack, thus raising the superheat and stack temperatures and impairing the efficiency.

The results which placed the point on the curves for the *B* test on boiler No. 3 nearest to the curves of No. 2 were obtained when this boiler was developing an average horsepower 11 per cent in excess of that developed by No. 2 in the similar test. When the relative horsepower and the abnormal external influences are taken into consideration, it will be seen that the results obtained on the three boilers corroborate in a striking and conclusive manner the relative value of the three forms of baffling.

Fig. 9 indicates in full lines the stack temperature noted for each arrangement of baffles and in dotted lines the degrees of superheat developed in each case. It will be noted that the curves for stack temperature and for superheat in the cases of boilers Nos. 2 and 3 are almost concentric, and that, while No. 3 developed the highest stack temperature, No. 2 ran above it in superheat temperature. The unusually low stack temperature in the case of boiler No. 2 is undoubtedly due to the fact that it was impossible to locate the pyrometer in the breeching of this boiler in such a way as to avoid the cooling due to leakage in the dampers of the other two boilers. It was possible in No. 1 and No. 3, however, to locate the pyrometer in such a way as to avoid this difficulty.

As has been mentioned before, in the *B* test on boiler No. 1 the top baffle was not carried tight against the rear water leg, as this was put in temporarily. This would easily explain the unusually high superheat temperature for this test. The superheat temperature developed was in all instances higher in case *B* than in any of the other cases. Reference to the diagrams showing the location of baffles will make this clear, as it will be seen that the larger part of the hot gases pass through the superheater.

Conclusions as to Completeness of Tests

The *D* arrangement of baffles not only shows in each test an unquestionable superiority over the other arrangements from the standpoint of efficient evaporation, but it meets the other requirements for a thoroughly satisfactory commercial arrangement of baffles. It develops a low superheat temperature, which, as long as the steam is thoroughly dry, is considered of advantage in the case of the apparatus in use; it does away with inactive and dead air pockets, which is immediately apparent from an examination of Figs. 6 and 7; it presents

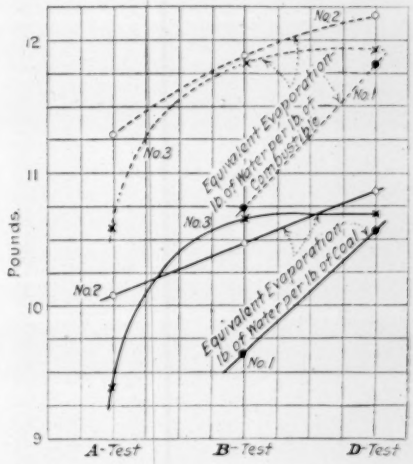

Fig. 8 Curves Showing Equivalent Evaporation per Lb. of Coal and per Lb. of Combustible, Cases *A*, *B*, *D*, Boilers Nos. 1, 2 and 3

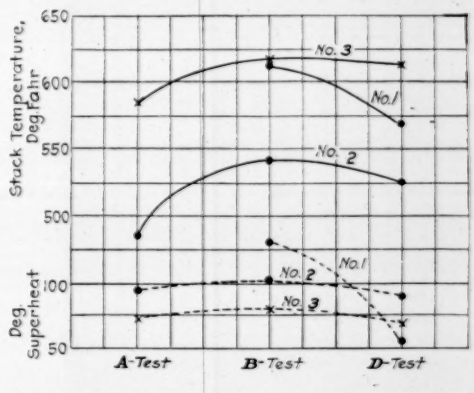

Fig. 9 Curves Showing Stack and Superheat Temperatures in Deg. Fahr., Cases *A*, *B*, *D*, Boilers Nos. 1, 2 and 3

an arrangement of baffles which may be easily blown by the soot blowers, and with this arrangement of baffles the boiler stands up satisfactorily to considerable overload.

Recommendations as to Further Research

While the principles involved in these tests and the results brought out by them will be true to a greater or less degree in the case of all boilers of similar design, it would probably be well before adopting a certain type of baffling in any boiler to conduct a series of tests to determine such details as the exact distance from water legs to baffles and the effect of various arrangements of baffles on draft, as this will vary for

each stack. The location of the baffles will be limited to some extent by the fact that they can be put only in certain courses of tubes that are accessible. The kind and quality of coal used will affect the results obtained, and an arrangement of baffles which would be thoroughly satisfactory in the case of a coal high in fixed carbon and low in volatile might prove unsatisfactory in the case of a highly volatile coal. The grate area and depth, the height of the bridge wall, the size of the combustion chamber and other factors will enter into the matter of the thorough burning of the coal. Whatever influence these factors may have, the arrangement of the baffles will influence to a considerable degree the matter of fuel economy.

CONCLUSION

The high evaporation obtained when using coal averaging less than 14,000 B.t.u. per lb. indicates that the boiler practice as a whole was unusually good. In one instance an average efficiency for the test of 75.2 per cent was obtained.

While the efficiency obtained during these tests is unusually high as compared with what is considered good practice, it is to be noted that the tests recorded are merely one stage of a continuous test which has been made on these boilers for the past nine months and to which the best principles of boiler practice have been applied. The improvements made represent not only those gained by a study of the theory of boiler practice, but those gleaned from several years of continuous boiler testing under similar conditions.

The improvement over these nine months has been gradually noted after changing of grate area, height of bridge wall, method of firing and arrangement of baffles to suit the grade of coal used. The drums and tubes are kept thoroughly clean within and without, air leaks of all kinds are carefully avoided, the boilers are equipped with Dutch ovens and two of them are protected with asbestos covering. The firemen are thoroughly trained, work eight-hour periods, and, because of the similar load conditions for each shift, are kept constantly on that shift. The increased efficiency thus brought about is reflected not only in the evaporation per pound of coal, but is corroborated by a corresponding decrease in pounds of coal per kilowatt of output.

One of the primary reasons for the installation of a battery of three 500-hp. boilers rather than two of larger capacity was the advantage to be gained in the matter of efficiency when the boiler could be loaded for the full period to its rated capacity or better. A glance at the tabulation of boiler tests (see Table 1) will indicate that this was the case during these tests.

The conduct of such a test under commercial operating conditions brings into it certain factors beyond the control of the engineer. At first blush this appears to be a disadvantage, but when it is considered that the practical problems which the engineers must face are invariably influenced by unusual conditions and that one of the most important phases of engineering practice is the determination of these conditions and the explanation of their bearing upon the problem under consideration, it will be seen that such a test under operating conditions, in which there are many unforeseen influences, may be made of more value than a laboratory test, where such conditions would probably not be found. Another feature to be considered is that an expenditure of three or four thousand dollars for fuel and labor would hardly be made, even if justified by the results, except under operating conditions.

The conduct of such a series of tests, while a tedious undertaking, is one which would amply repay any operating engineer who is responsible for the burning of a large amount of fuel. There are few improvements in the boiler room that can be made at comparatively small expense which offer such encouraging possibilities along the line of the more economical evaporation of water as the arrangement of baffles in the boiler flues to meet best the definite conditions peculiar to any boiler room.

ADVANTAGES OF HIGH PRESSURE AND SUPERHEAT AS AFFECTING STEAM-PLANT EFFICIENCY

BY ESKIL BERG,[1] SCHENECTADY, N. Y.

THE advantages of the steam turbine as a prime mover are today too well known to need much discussion. It is, however, interesting to note that in the early stages of the development, when the thermodynamic efficiency was only about 50 or 60 per cent, it still had such great advantages over its competitor, the reciprocating engine, that it rapidly began to take its place. The chief reason for this is, of course, that outside of its mechanical advantages of simple rotation, it could advantageously use steam at the lower pressure ranges, and a vacuum of 28½ in. or higher is now called for as standard by larger central stations.

The development of the steam turbine has advanced very rapidly, the designer has constantly had higher efficiency in view, and has in this respect succeeded so that today turbines are in operation that are giving a thermodynamic efficiency of almost 90 per cent. While in the future this already high efficiency may be improved by a small percentage, we will have to look to other features of the power plant for further gains in fuel economy. Such gains can be made by increasing the temperature range of the steam, but as the lower range is fixed by the temperature of the cooling water, the gain must be made by going to a higher temperature in the beginning of the cycle, which can be done either by the use of higher steam pressure or by the application of superheat. It will be shown later that a combination of both will give the best results.

EFFICIENCY OF A TURBINE

The thermodynamic or Rankine-cycle efficiency of a turbine is the ratio of the mechanical energy taken out of the steam by the turbine to the total energy in the supplied steam when this steam is expanded adiabatically from the pressure at the throttle valve to the exhaust pressure in the turbine casing. (Adiabatic expansion takes place when the lowering of the temperature of the steam is done entirely by extraction of work from the steam.)

The steam consumption of a turbine when connected to an

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electric generator is generally stated in pounds of steam per kilowatt-hour, and is the amount of steam required to deliver one kilowatt of electrical energy for one hour.

"Theoretical water rate" is a term generally used in all turbine investigations, and is the ratio of one kilowatt-hour expressed in foot-pounds (2,654,000) to the available energy in one pound of steam expressed in foot-pounds. The ratio, therefore, between the theoretical water rate and the actual measured water rate gives the efficiency. When the turbine is connected to an electric generator the combined efficiency of turbine and generator is generally given.

Formula for Calculation of Available Energy

The formula for calculating the available energy of steam expressed in foot-pounds, either dry or superheated, when expanding adiabatically to any back pressure, is seldom found in handbooks or textbooks, and when such formulæ are found they are rather complex and difficult to use. The formula can, however, be made very simple when expressed as the difference between the total heat input and the heat left in the liquid together with the latent heat in the mixture at the lower pressure. The formula then becomes:

Available energy in ft-lb. =

$$778\,[H_1 + C_p t_1 - (q_2 + x_2 r_2)]$$

where H_1 = total heat of saturated steam at initial pressure p_1
C_p = specific heat of superheated steam
t_1 = deg. fahr. superheat at pressure p_1
q_2 = heat of the liquid at lower pressure p_2
x_2 = quality of the steam at pressure p_2
r_2 = latent heat at pressure p_2.

All of these quantities are found in any steam table except x_2 (dryness factor), which is, however, easily calculated from the fact that the entropy is constant before and after the expansion.

Entropy of superheated steam is:

$$C_p \log_e \frac{T_1 + t_1}{T_1} + \frac{r_1}{T_1} + \phi_1$$

Entropy of moist steam is:

$$\frac{X_2 r_2}{T_2} + \phi_2$$

By making these equal and solving for x_2 there results:

$$x_2 = \frac{T_2}{r_2}\left(C_p \log_e \frac{T_1 + t_1}{T_1} + \frac{r_1}{T_1} + \phi_1 - \phi_2\right)$$

T_1 = absolute temperature at pressure p_1
T_2 = absolute temperature at pressure p_2
ϕ_1 = entropy of water at pressure p_1
ϕ_2 = entropy of water at pressure p_2

Example. Find the available energy of one pound of steam when expanding from 250 lb. gage pressure, with 250 deg. superheat, to 29 in. vacuum. (0.5 lb. abs.)

Available energy $= 778\,[H_1 + C_p t_1 - (q_2 + x r_2)]$
$H_1 = 1202.3$
$C_p = 0.553$
$t_1 = 250$
$q_2 = 48$
$r_2 = 1046.7$

$$x_2 = \frac{T_2}{r_2}\left(C_p \log_e \frac{T_1 + t_1}{T_1} + \frac{r_1}{T_1} + \phi_1 - \phi_2\right)$$

$T_1 = 461 + 406.2 = 867.2$
$t_1 = 250$
$r_1 = 821.6$
$\phi = 0.5739$
$r_2 = 1046.7$
$T_2 = 461 + 80 = 541$
$\phi_2 = 0.0932$

$$x_2 = \frac{541}{1046.7}\left(0.553 \log_e \frac{1117.2}{867.2} + \frac{821.6}{867.2} + 0.5739 - 0.0932\right)$$
$$= \frac{541}{1046.7}\left(0.553 \times 0.2546 + 0.947 + 0.5739 - 0.0932\right)$$
$$= 0.5168 \times 1.5685 = 0.812$$

Dryness factor $= 0.812$.

Available energy $=$
$778\,[1202.3 + 0.553 \times 250 - (48 + 0.812 \times 1046.7)] = 778 \times 444.3 = 346{,}000$ ft-lb.

[Theoretical water rate per kw-hr. $= 2{,}654{,}000/346{,}000 = 7.67$ lb.]

Gain by the Use of High Steam Pressure

It has long been recognized that a very large saving in fuel could be obtained by the use of high steam pressure. As early as 1897 DeLaval in Sweden supplied all the power for lighting the Exposition of Arts and Industries in Stockholm with his turbo-generating sets operated from boilers of his own design, using over 1500 lb. pressure. The units used were

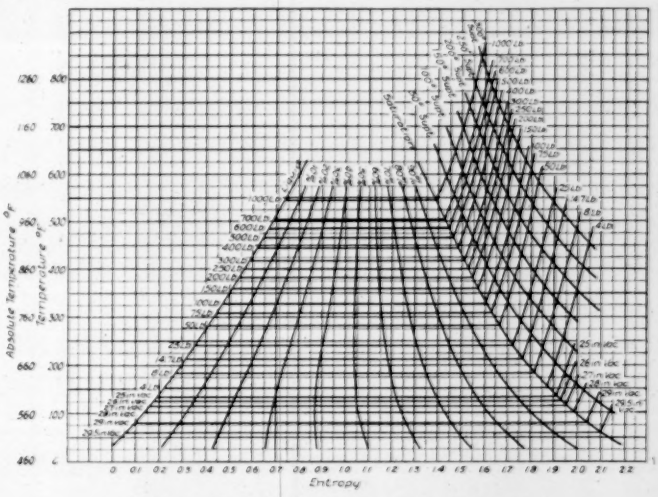

Fig. 1 Entropy-Temperature Curves

naturally small, four of them having 100 hp. each and two of them 50 hp. each.

Boiler manufacturers in this country are today prepared to build boilers for 350 lb. pressure and see no difficulties in going to 500 lb. or even higher.

The theoretical gain due to the use of high steam pressure is plainly illustrated in Table 1, in which case 1 lb. of dry steam at 200 lb. pressure expanded to 28½ in. of vacuum is considered unity. It will be seen that by raising the boiler pressure to only 500 lb., there is a saving in fuel of 14.43 per cent. In money this saving would amount to about $200,000 a year in a plant burning about 900 tons a day with coal costing $5 a ton.

Theoretical Gain by Superheat

The theoretical gain by superheat is shown by Table 2, which is calculated on the basis of an initial pressure of 250 lb. gage expanded to a 29 in. vacuum. It will be seen that this gain is very small, being only 2.9 per cent when superheating up to 300 deg.

Practical Gain by Superheat

The practical gain by the use of superheat is often expressed by saying that the water rate is reduced 1 per cent for a certain number of degrees of superheat. The amount of this decrease varies with turbines of different design, but a figure

frequently used is 1 per cent gain in water rate for every 12.5 deg. of superheat. Column 5, Table 2, is based upon this assumption.

The actual net gain of fuel in per cent is therefore shown by column 8, which is the difference between column 7 and column 4. It will there be seen that the practical gain by superheat is about two and a half times as great as the theoretical. The reason for this large practical gain is that in a well-designed turbine of, say, the impulse type, the magnitude of the total losses is made up in about the following proportions when dry initial steam is used:

	Per Cent
Loss due to friction in nozzles and blades and windage loss of disks and blades	20
Leakage loss	3
Rejected energy (due to residual steam velocity)	3
Bearings, packings, etc	1
Total losses	27
Efficiency of turbine	73

It will be seen that the first item is by far the most important one, and it is this item which is reduced by the use of superheat. The use of 200 deg. superheat will reduce the friction

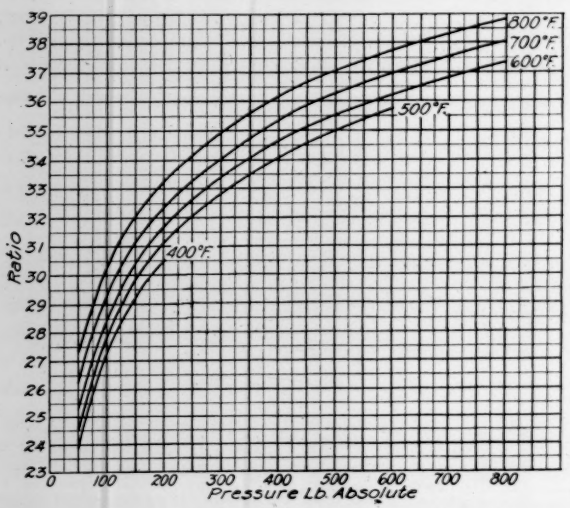

FIG. 2 CURVES SHOWING RATIO OF AVAILABLE B. T. U. IN STEAM TO TOTAL HEAT IN STEAM, FEEDWATER AT 90 DEG. FAHR.

and windage loss about one quarter or to 15 per cent, and the total loss would then be 22 per cent, making the turbine efficiency 78 per cent. This reduction is effected by the superheat reducing the moisture in all the stages. The reduction is best shown by the entropy-temperature diagram, Fig. 1. From this diagram it will be seen that starting with steam initially dry at 265 lb. absolute pressure and expanding it adiabatically to 29 in. vacuum through a turbine of 100 per cent efficiency, would result in steam of about 26.5 per cent moisture, whereas if the steam had been superheated to say 250 deg., this moisture would be reduced to about 19 per cent, a reduction of almost 30 per cent. In an actual turbine this percentage of moisture is of course a great deal lower, depending upon the efficiency.

Table 3 gives approximately the condition of the steam in all the stages of a ten-stage turbine, assuming the turbine has 80 per cent efficiency, is supplied with steam at 250 lb. gage pressure, 250 deg. superheat, and is exhausting into 29 in. vacuum. For comparison the last column of the table gives the steam condition in this turbine had the steam been initially dry.

EFECT OF MOISTURE ON FRICTION

A great many formulæ and curves are given by various authors based upon experimental and theoretical data for calculating the friction losses, and they all have a constant which varies according to the conditions of the steam. Professor Moyer, for example, in his book on steam turbines gives a formula for rotation losses of buckets and wheel disks in which the constant C is as follows:

Superheat, deg.			Per cent moisture		
100	50	0	5	10	20
C = 0.875	0.93	1.00	1.08	1.25	2.00

In other words, the friction loss is twice as great with 20 per cent moisture as it is with dry steam.

EFFECT OF THROTTLING

Throttling of dry steam always produces superheat; and it has often been said for this reason that there is practically no loss due to throttling, which is true as far as heat is concerned. There is, however, a considerable loss of available energy. The amount of superheat obtained by throttling is easily calculated because the total heat before and after throttling is the same. Assume that steam at 200 lb. absolute pressure is throttled down to 100 lb. absolute pressure:

Total heat of dry steam at 200 lb. abs. = 1198.1

Total heat of dry steam at 100 lb. abs. = 1186.3

Assume that the specific heat of steam is 0.5:

$$1198.1 = 1186.3 + 0.5 \times t_1, \text{ or } t_1 = 23.6 \text{ deg.}$$

The available energy, however, assuming that the steam in both cases is expanded to 28.5 in. vacuum, is:

TABLE 1 THEORETICAL GAIN DUE TO THE USE OF HIGH STEAM PRESSURE

Absolute pressure, lb.	Corresponding temperature, deg. fahr.	Total heat	Increase in total heat, per cent	Available energy in ft-lb. expanding to 28.5 in. vacuum	Increase of available energy, per cent	Net gain in fuel, per cent
200	381.9	1198.5	....	272,000	....	....
300	417.5	1201.9	0.28	293,000	7.72	7.44
400	444.8	1202.5	0.33	304,500	11.95	11.62
500	467.2	1201.7	0.27	312,000	14.7	14.43
600	486.5	1199.8	0.11	319,000	17.2	17.09
700	503.4	1197.4	0.902	323,000	18.7	18.79
800	518.5	1194.4	−0.342	327,000	20.2	20.54
900	532.3	1191.1	−0.617	329,000	20.9	21.51
1000	545.0	1187.6	−0.909	331,000	21.7	22.6

TABLE 2 THEORETICAL GAIN DUE TO THE USE OF SUPERHEAT

Degrees superheat	Temp., deg. fahr.	Total available energy per lb. of steam	Total B.t.u. per lb.	Per cent increase in coal to produce superheat	Per cent increase available energy due to superheat	Net theoretical gain, per cent	Actual gain, per cent	Actual net gain, per cent
(1)		(2)	(3)	(4)	(5)	(6) = (5−4)	(7)	(8) = (7−4)
0	406	298,000	1202.3	....	....	....	..	....
50	456	308,500	1237.0	2.89	3.53	0.64	4	1.11
100	506	318,000	1264.6	5.18	6.72	1.54	8	2.82
150	556	327,500	1290.5	7.33	9.90	2.57	12	4.67
200	606	336,000	1315.6	9.45	12.75	3.30	16	6.55
250	656	341,500	1340.5	11.50	14.60	3.10	20	8.50
300	706	347,000	1365.3	13.55	16.45	2.90	24	10.45

270,800 ft-lb. with 200 lb. pressure, dry steam

240,200 ft-lb. with 100 lb. pressure, 23.6 deg. superheat, or a loss in available energy of about 11 per cent.

GAIN BY THE COMBINED USE OF HIGH STEAM PRESSURE AND SUPERHEAT

High steam pressure with no superheat has the disadvantage, as will be seen by the entropy diagram, of producing more moisture throughout the turbine, which means more friction. It is therefore advisable to combine high pressure with superheat so as to produce a more efficient turbine.

Fig. 2 shows the ratio of available British thermal units in steam to the total heat in the steam, with feedwater at a temperature of 90 deg.

The present practice in power plants in this country is to use, with turbine drive, a steam pressure of 200 lb. gage and about 150 deg. superheat (temperature of 538 deg.), with a vacuum of 28.5 in. From Fig. 2 it will be seen that the ratio of maximum available heat for work to the total heat is only about 31.25 per cent.

TABLE 3 CONDITION OF STEAM IN THE VARIOUS STAGES OF A TEN-STAGE TURBINE

Assumptions: Steam pressure, 250 lb. gage; superheat, 250 deg.; vacuum at exhaust, 29 in.; turbine efficiency, 80 per cent.

Stages	Steam pressure, lb. per sq. in. abs.	Temperature of steam, deg. fahr.	Superheat, deg.	Per cent moisture	Per cent moisture assuming steam initially dry.
Steam chest	265	656	250	....	....
1	120	501	160	....	4.40
2	68	421	120	....	6.80
3	48	354	75	....	8.15
4	28	277	30	....	9.80
5	16	216	...	0.6	11.50
6	9	188	...	2.0	13.00
7	4.7	160	...	4.0	14.50
8	2.4	133	...	6.5	16.00
9	1.1	107	...	8.0	17.30
10	0.5	79	...	10.5	18.70

Steam temperatures as high as 700 deg. fahr. are now used in Europe, which with a steam pressure of 500 lb. would give 233 deg. superheat. The ratio of available heat for work would then be about 36.3 per cent, or a fuel saving over the above conditions of 16 per cent.

Turbine generator sets are now built having an overall efficiency of over 80 per cent including generator losses, which with a boiler efficiency of 80 per cent would give an efficiency from fuel amounting to $36.3 \times 0.80 \times 0.80 = 23.25$ per cent. One kilowatt-hour = 3412 B.t.u., therefore the B.t.u. required to produce 1 kw-hr. at the switchboard $= 3412/0.2325 = 14{,}600$.

On the other hand, had 800 lb. pressure and 800 deg. temperature been used, the efficiency would have been 38.75 per cent; and using a turbine efficiency of 85 per cent and a boiler efficiency of 88 per cent (which is obtainable with liquid fuel, forced draft, and preheated combustion air), a kilowatt-hour could be obtained by:

$$38.75 \times 0.88 \times 0.85 = 29 \text{ per cent, or}$$

$$\frac{3412}{0.29} = 11{,}750 \text{ B.t.u., or}$$

$$\frac{11{,}750}{19{,}000} \text{lb. of fuel oil} = 0.62 \text{ lb.}$$

Diesel-engine advocates now claim a consumption of about 0.55 lb. of fuel oil per kw-hr., but with a fuel about 50 per cent higher in price than the grade of fuel which can be satisfactorily burned under a boiler. It will thus be seen that when full advantage has been taken of the various processes that are used in transforming the energy of the fuel into mechanical energy through the medium of steam, the steam process compares quite favorably with results obtained at the present time with internal-combustion engines.

The conservation of our fuel resources is a subject which is being very carefully studied by all power-plant engineers at the present time, and improvements along the lines that have been discussed in this paper are now receiving serious consideration.

DISCUSSION

In the discussion following the presentation of the paper a number of questions were propounded which were taken up in order by the author as follows:

Dr. Thurston's remark to the effect that the most efficient all-round superheat would be that which would give dry steam in the exhaust, he said, was correct at the time when moderate steam pressure was used and the efficiency of the prime mover was around 50 per cent. Assuming however an efficiency in the prime mover of 80 per cent, 200 lb. steam pressure, and an exhaust pressure of 28½ in. of vacuum, in order to obtain dry steam at the exhaust the superheat would be above 1000 deg. or in a territory that was practically unknown at the present time.

When the high-pressure boiler was developed, it would, in his opinion, be smaller, lighter, and cheaper per horsepower than the present boilers.

In regard to the question of moisture, for a given turbine efficiency the moisture was, of course, the same as the theoretical. If in practice the moisture was found to be excessive, it must be caused by the initial condition of the steam, either having less superheat than assumed, or it might be quite wet when entering the turbine.

In reply to the question whether the first 50 deg. of superheat was not more effective than the last 50 deg. of the 200, he would say that it was, because it reduced the moisture in the high-pressure end of the turbine where the friction loss is greatest. Turbine manufacturers recommended 50 deg. of superheat because it was easily obtained and it at least assured them of dry steam at the throttle. Very few boilers gave dry steam in practice.

In regard to high superheat showing a great saving in fuel with reciprocating engines, it was to be remarked that records of several European vessels operating with steam temperatures around 700 deg. showed that the saving in fuel was in some of them as high as 17 per cent and was sufficient to pay for the cost of installing the apparatus for producing superheat in a few trips across the ocean.

As to the inquiry made regarding the durability of packings, etc., at the higher pressures and temperatures, he would say that in all probability no packing would be used in the piping system and all joints would have to be welded. This, however, should not raise any difficulty. The paper had been primarily intended to point out the direction in which it was necessary for all to work in order to improve fuel economy, and to show that the advantages derived by the use of high steam pressure and superheat were infinitely greater than the disadvantages due to the few practical difficulties which had to be overcome.

A NEW SYSTEM OF REGENERATIVE EVAPORATION

By WM. L. DE BAUFRE,[1] ANNAPOLIS, MD.

A NEW patented system of regenerative evaporation has been brought out recently in which the steam economy of multiple-effect operation is obtained with a single evaporator shell. This system has certain other unique advantages, and it may be applied to any make or type of evaporator. A brief description of the system will be given together with some of the test results obtained; but before doing so, the ordinary single- and multiple-effect systems will be described.

Single and Multiple-Effect Evaporators

The simplest method of evaporation is by the direct application of fire as diagrammatically illustrated in Fig. 1. The solution to be evaporated is contained in evaporator *E*, the vapor distilled off is condensed in condenser *C*, and the condensed vapor is collected in tank *T*. Evaporation takes place under atmospheric pressure and consequently at 212 deg. fahr. unless valve *V* be partly closed to throttle the flow of vapor to condenser *C*.

If evaporator *E* has not been designed with sufficient disengaging surface or ample vapor space, or if proper baffles are not provided, priming or the carrying over of particles of solution with the vapor will occur at atmospheric pressure. This priming may often be eliminated by operating at 5 lb. gage or higher for the reason that the volume of the vapor is thus considerably reduced. For example, the volume of 1 lb. of water vapor at 5 lb. gage is about 25 per cent less than at atmospheric pressure.

A considerable improvement in operation results by heating evaporator *E* with steam from a boiler *B*, see Fig. 2, thus providing a more readily controlled source of heat which is less liable to injure the evaporator *E* or its contents. The condensed steam is collected at *S*. Fig. 2 also shows the application of a pump *P* to produce a vacuum in evaporator *E* and thus carry on the evaporation at a temperature less than 212 deg. in cases where a better product is obtained thereby.

To maintain the evaporation in the single-effect plant shown in Fig. 2, somewhat more than one pound of steam must be supplied evaporator *E* for each pound of water vapor distilled off to condenser *C*. The ratio of steam to vapor varies but slightly with the steam and vapor pressures, but is greatly affected by the solution feed temperature. It is also affected by radiation from the evaporator and by loss of heat in the hot solution which must be discharged when the concentration within the evaporator reaches the limiting value. For sea-water evaporators, the loss due to radiation and blow-down is covered by assuming it equal to 5 per cent of the heat supplied in the steam.[2] Assuming an initial steam pressure of 125 lb. gage and atmospheric vapor pressure, it may readily be shown that the weight of steam supplied per pound of vapor produced is reduced from about 1.20 lb. with a feed temperature of 80 deg. fahr. to about 1.05 lb. with a feed temperature of 210 deg. Many methods of preheating the solution have been proposed and used, the most common probably being with exhaust steam from the evaporator feed pump.

Any further improvement in the steam economy of evaporators has been gotten in the past by resorting to the multiple-effect arrangement. Referring to Fig. 2, steam from boiler *B* is supplied to the steam jacket of the first effect *E*, but the vapor produced in *E*, instead of passing to condenser *C*, is condensed in the steam jacket of a second effect. Similarly, the vapor produced in the shell of the second effect is condensed in the steam jacket of a following effect, and so on until finally the vapor from the last effect is condensed in condenser *C*. On the assumption that 1.20 lb. of steam or vapor must be supplied each effect for the evaporation of 1 lb. of vapor therein, the relative steam economies in Table 1 are obtained for multiple-effect evaporators.

An inspection of Table 1 shows that very little additional saving in steam results by adding effects beyond the fourth; in fact, most multiple-effect plants are limited to three or four effects with their complicated arrangements of piping, valves, traps, etc.

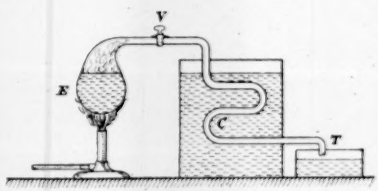

Fig. 1 Simple Method of Evaporation by Direct Application of Fire

The New Regenerative Evaporative System

The essential feature of the new regenerative evaporative system which has been developed by the Regenerative Evaporator Company, of Baltimore, Md., is a highly efficient steam-

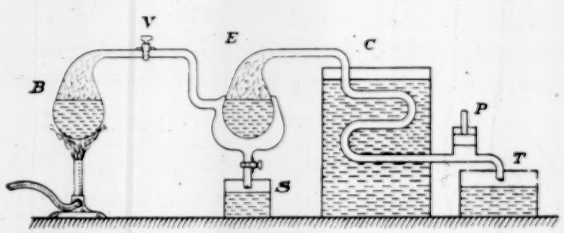

Fig. 2 Method of Evaporation in which Evaporator *E* is Heated with Steam from Boiler *B*

TABLE 1 RELATIVE ECONOMY OF MULTIPLE-EFFECT EVAPORATORS

Number of effects	Steam economy per lb. of vapor evaporated, lb.	Saving in comparison with single-effect operation, per cent	Saving due to each additional effect, per cent
1	1.20	..	..
2	0.65	46	46
3	0.48	60	14
4	0.39	67	7
5	0.34	72	5
6	0.30	75	3

[1] Mechanical Engineer, U. S. Naval Engineering Experiment Station. Mem.Am.Soc.M.E.

[2] See Salt-Water Evaporators, Calculation of Blow-Down Loss, Heat Balance, Etc., by Wm. L. De Baufre, *Journal of the American Society of Naval Engineers*, November, 1915.

Abstract of a paper presented at a meeting of the Baltimore Section of The American Society of Mechanical Engineers, November 7, 1917.

jet compressor known as the "Jetflo" compressor and shown in Fig. 3. When applied to an evaporator in the manner represented in Fig. 4, the steam economy of a multiple-effect plant is attained with a simplicity of operation even greater than that of the ordinary single-effect plant.

Referring to Fig. 3, *S* is connected to the high pressure steam main, *V* to the vapor pipe from the evaporator shell and *E* to the steam jacket or more usually the steam coils within the evaporator shell, as represented in Fig. 4. With valve 3 closed and valve 2 open, the steam entering at *S* passes

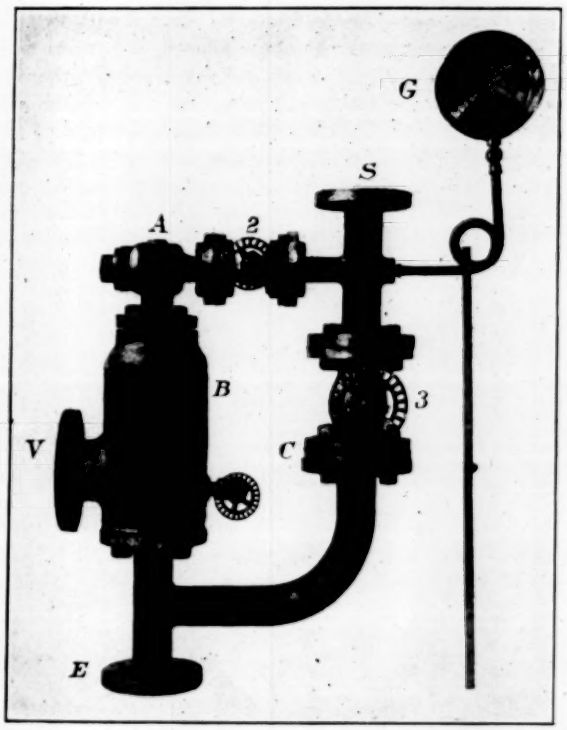

FIG. 3 THE JETFLO COMPRESSOR

through a strainer in the head *A* and expands through nozzles in the compressor body *B*. At the outlet of the nozzles the steam by reason of its high velocity entrains a certain amount of vapor drawn from the evaporator through opening *V*. The commingled steam and vapor are compressed in a diffuser tube, also in the body *B* of the compressor, and are discharged through *E* into the steam coils of the evaporator with a pressure higher than the vapor pressure within the evaporator shell but lower than the initial steam pressure. Part of the vapor produced within the evaporator shell passes directly to the distiller condenser in the usual manner. The relative amounts of entrained and non-entrained vapor per pound of steam depend upon the design of the compressor and the temperature of the solution fed to the evaporator.

With valve 2 closed and valve 3 open, the steam bypasses the compressor and is supplied directly to the steam coils within the evaporator shell in the usual manner. An orifice in plate *C*, however, limits the flow of steam at the pressure available to that required for producing the maximum safe capacity of the evaporator.

The gage *G* not only indicates the pressure of the steam supplied but also the steam consumption of the evaporator with either the compressor or the bypass orifice in use. The inner scale is graduated to show the steam pressure in pounds per square inch gage. The outer scale is graduated to the capacity at which the evaporator is working, and when the reading is multiplied by a suitable constant, it gives the steam flow in pounds per hour.

The relation between the compressor and the evaporator is shown diagrammatically by Fig. 5 on which have been entered the data from a test run. The design of the compressor was such as to consume 147.8 lb. of steam per hour at 175 lb. gage pressure. The vapor pressure of 5 lb. gage within the evaporator shell was maintained by throttling the flow of non-entrained vapor to the distiller condenser. The efficiency of the compressor and the efficiency of the evaporator heating surface were then such as to set up a temperature difference between shell and coils of 16.8 deg. fahr. with 208.2 lb. of vapor entrained in the 147.8 lb. of steam, making 356 lb. of commingled steam and vapor to be condensed in the coils. There were produced in all 323.8 lb. of vapor, of which 115.6 lb. passed to the distiller condenser.

The data of Fig. 5 have been reduced to the basis of 1 lb. of vapor in Fig. 6, and the corresponding numbers of heat units have been entered thereon. From the standpoint of the evaporator alone, the performance is usual for a feed temperature of 200 deg. fahr., 1.10 lb. of commingled steam and vapor being required to produce 1 lb. of vapor. The function of the compressor was to make up 0.64 lb. of this mixture with entrained vapor, thus reducing the steam to 0.46 lb. The application of this compressor has thus saved 58 per cent of the steam that would have been required without it.

TEST RESULTS

The above data were obtained in a test made by Mr. M. C. Stuart at the U. S. Naval Engineering Experiment Station, Annapolis, Md., the results of which were summarized and

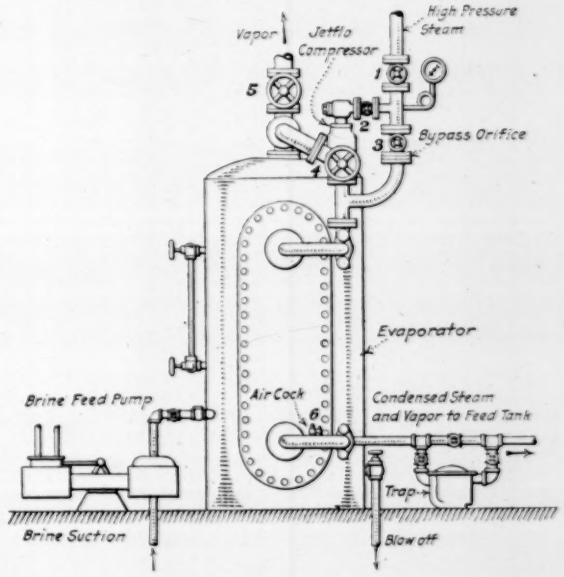

FIG. 4 COMPRESSOR OF FIG. 3 APPLIED TO AN EVAPORATOR

published in the *Journal of the American Society of Naval Engineers* for February 1918. [See abstract in THE JOURNAL, May 1918, pp. 245-247.—EDITOR.] While the compressor used was designed for 20 sq. ft. of heating surface in the evaporator and for an initial steam pressure of 175 lb. gage, the test covered the performance with 10 to 30 sq. ft. installed and with a range of initial steam pressure from 100 to 250 lb. gage.

The tabulated results of this test showed that the steam

economy was practically constant with a given evaporator over the wide range of steam pressures covered (averaging 0.047 lb. steam per lb. of total vapor with 20 sq. ft. of heating surface installed); and further, that the capacity produced was nearly proportional to the steam pressure (absolute). Hence the capacity of this regenerative system can be controlled without materially affecting its efficiency simply by throttling the steam supply.

One advantage of this regenerative system, however, is that the compressor can be designed for the desired capacity at the steam pressure available, thus eliminating the necessity of carefully regulating the steam supply. On naval vessels, the automatic pressure-reducing and regulating valve which it has been customary to install, may be eliminated when the compressor described is used.

Overload capacity at reduced efficiency is provided by the bypass, the orifice in which may be of such size as to pass at the available pressure the quantity of steam required to produce the maximum safe capacity of the evaporator. Since a careless attendant cannot operate the evaporator above its safe capacity, the purity of the fresh water obtained is assured. The operation of the evaporator is simplified by the application of such a compressor to the maintainance of the proper solution level within a single shell.

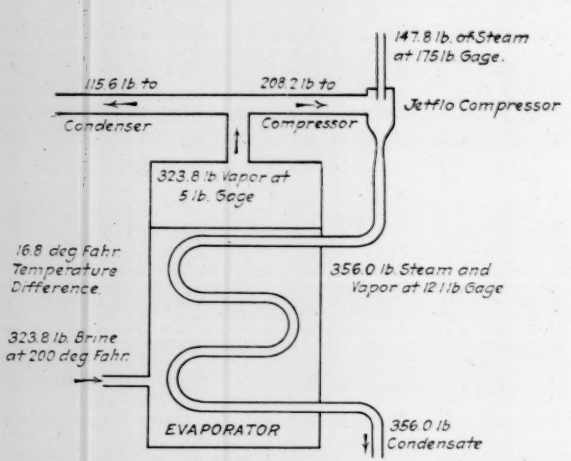
147.8 lb. of Steam at 175 lb Gage.
115.6 lb to Condenser
208.2 lb to Compressor
Jetflo Compressor
323.8 lb Vapor at 5 lb. Gage
16.8 deg Fahr Temperature Difference.
356.0 lb Steam and Vapor at 12 lb Gage
323.8 lb. Brine at 200 deg Fahr
EVAPORATOR
356.0 lb Condensate

FIG. 5 DIAGRAMMATIC REPRESENTATION OF ACTION AND PERFORMANCE OF REGENERATIVE EVAPORATOR

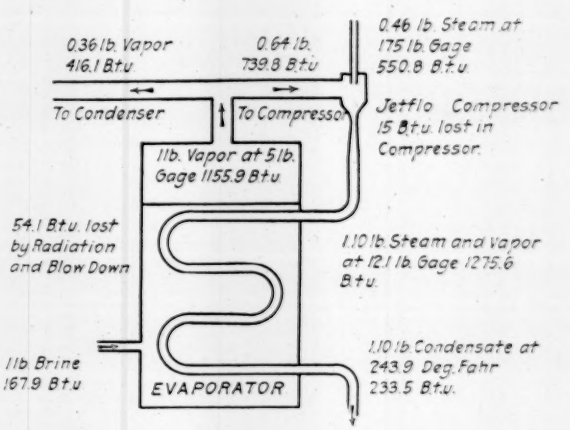
0.36 lb. Vapor 416.1 B.t.u.
0.64 lb. 739.8 B.t.u.
0.46 lb. Steam at 175 lb. Gage 550.8 B.t.u.
To Condenser
To Compressor
Jetflo Compressor 15 B.t.u. lost in Compressor.
1 lb. Vapor at 5 lb. Gage 1155.9 B.t.u.
54.1 B.t.u. lost by Radiation and Blow Down
1.10 lb. Steam and Vapor at 12.1 lb. Gage 1275.6 B.t.u.
1 lb Brine 167.9 B.t.u.
EVAPORATOR
1.10 lb. Condensate at 243.9 Deg. Fahr 233.5 B.t.u.

FIG. 6 HEAT BALANCE OF REGENERATIVE EVAPORATION SYSTEM

OPERATION OF EVAPORATORS

Several points in the operation of evaporators which must be observed are: freeing the steam coils of air; blowing down the concentrated solution; and scaling the coils.

In all apparatus heated by condensing steam, air and other non-condensable gases collect at the bottom of the steam space for the reason that air is about 50 per cent denser than dry saturated steam of the same pressure and temperature. Air cocks should therefore be provided on all evaporators near the point where the condensed steam leaves, as indicated at 6 in Fig. 4. This air cock should always be open to allow a perceptible escape of vapor during the operation of the evaporator; otherwise, the steam coils will become air bound and the capacity of the evaporator reduced.

As evaporation continues in an evaporator, the concentration of the solution increases with a consequent reduction in the efficiency of the heat-transferring surface. Where the object of evaporation is to secure a product of a given density, the process must of course be continued until the desired concentration is attained. In the evaporation of sea water, however, the limiting concentration or salinity of the brine within the evaporator is determined by the danger of priming and the formation of scale and should not be permitted to exceed 3/32. A greater salinity is prevented either by a continuous or an intermittent blow-down. In the former case, the feed and blow-off valves are so regulated as to maintain a constant salinity of 3/32. In the latter case, the contents of the evaporator are completely discharged when the salinity reaches 3/32 and the shell refilled to the working level with sea water. The latter method is recommended for use with the compressors described by reason of the greater average efficiency of the heating surface and the cracking of the scale as explained below. Also, a schedule of blowing down can be worked out and followed without the necessity of taking salinometer readings.

As the evaporation of a solution proceeds, especially of sea water, the heating surfaces become coated with scale. Certain recent types of evaporators are so arranged that the scale may be cracked off the heating surface without opening the evaporator. This is accomplished by first turning off the steam supply, blowing out the evaporator contents, refilling to the operating level with cold brine, and finally suddenly admitting steam again. Difficulty with scale is reduced by operating with a low concentration, a low temperature and a small temperature difference.

EVAPORATOR DESIGN

The steam economy of the ordinary single-effect or multiple-effect plant is practically independent of the design of the individual shells. The capacity, durability and ease of operation, however, are vitally affected by the design, so that different designs have been developed by experience for various classes of work. Some of the important points to be considered in design are: arrangement of steam space to produce a flow of steam across the heating surface and sweep away air and other non-condensable gases; arrangement of the solution space to produce if possible a circulation of the solution across the heating surface; sufficient volume of solution space to give a reasonable period between blow-downs; sufficient disengaging surface and vapor space to permit gravity separation of liquid from the vapor; placing of baffles so that the velocity of the vapor will be decreased rather than increased to aid the separation by inertia of the liquid from the vapor when the direction of flow is changed. With a Jetflo com-

pressor installed, the steam economy of the combination as well as the capacity is affected by the design of the evaporator.

APPLICATIONS

The application of a steam-jet compressor of the type considered to the ordinary single-effect plant reduces the steam consumption by one-half and more, and the capacity obtainable depends upon the amount and efficiency of the heating surface installed in the evaporator. There is always obtainable, however, the original maximum capacity of the evaporator by means of the bypass. The compressor adds little weight and occupies practically no additional space. It is noiseless in operation, has no moving parts and retains its initial efficiency indefinitely. It makes for simplicity and safety in operation. The steam consumption of the evaporator and capacity at which it is working are indicated at all times.

In comparison with a multiple-effect plant, the same steam economy is obtained by applying a jet compressor to a single shell. This shell can be operated at atmospheric pressure; while, in a multiple-effect plant, the several shells must be of sufficient strength to withstand the high vapor pressures to which they are subjected. In the regenerative plant only one solution level need be attended to, unless it is considered desirable to divide the plant into two shells either of which may be operated at, say, quadruple-effect steam economy independently of the other shell.

On naval vessels, particularly destroyers, where two evaporators are installed for double-effect operation, the installation of these compressors enables either evaporator to be operated at triple-effect efficiency independently of the other evaporator. For a capacity of 7500 gal. per day this amounts to a saving on each destroyer of approximately 100 gal. of fuel oil per day in comparison with double-effect operation, and 400 gal. in comparison with single-effect operation. On many of the present naval vessels, the full rated capacity of the evaporators can be obtained with such compressors operating at triple-effect efficiency.

On merchant-marine vessels it is usual to install one evaporator only for make-up feed. The installation of a Jetflo compressor reduces the amount of coal burned for this purpose by 50 per cent and more. On some vessels it has been customary to carry 100 to 200 tons of fresh water for make-up feed and not to use the evaporator. To produce 100 tons of fresh water with an evaporator equipped with the compressor described would require approximately 7 tons of coal. It is questioned whether more than 7 tons of coal are not burned to carry 100 tons of make-up feed 3000 miles across the Atlantic. With weighty material such as coal and metals, the total cargo is limited by weight and not by the volume of the cargo space: hence the absence of 100 tons of make-up feedwater would enable the carrying of just that additional amount of cargo.

In many steam-generating plants the question of securing pure make-up feedwater is an acute one, particularly where superheaters are used. The least amount of sediment carried over by the moisture in the steam is deposited on the superheater surfaces. The use of evaporators equipped with Jetflo compressors insures the purest obtainable make-up feedwater with minimum expenditure of fuel to obtain it.

For the evaporation of milk and similar materials requiring narrow ranges of temperature operation and consequently low temperature differences, these compressors are peculiarly adapted. The evaporation can be carried out at any desired temperature above or below that corresponding to atmospheric pressure, and with high steam economy and great simplicity in operation. They can be readily applied to evaporators now in operation with but slight changes in the piping only. They are also suitable for operation with any make or type of chemical evaporator in which the object of the evaporation is the concentration of the product.

THE PUBLIC INTEREST AS THE BEDROCK OF PROFESSIONAL PRACTICE

Enlivening Discussion of Mr. Cooke's Paper at the Spring Meeting on the Responsibilities and Obligations of Engineers and Their Organizations, with a Summary of the Objects of Various Professional Societies

A discussion at the Spring Meeting which evoked a great deal of interest was that upon the paper by Morris L. Cooke on The Public Interest as the Bedrock of Professional Practice.[1] This paper consists mainly of a review of the statements of purposes of various engineering and other professional organizations, as embodied in their constitutions or codes of ethics. The specific purpose of the author was to determine what has been, and is now, the attitude of engineering organizations toward the public interest. By this means he sought to develop the engineer's concept of his public relationships and responsibilities as contrasted with such relatively minor obligations as those to the profession of engineering, to a client, to fellow-engineers, and to himself.

THE AUTHOR,[2] in presenting his paper at the meeting, referred to features typical of the codes of the various engineering societies. These usually include references to an engineer's relations to his firm and his clients; his relationship to his fellow engineers; the maintenance of the standards of the profession; and some other requirements, as, for example, a deprecation of advertising.

In our own code we have introduced a section relative to the engineer's relations to the public which slightly, though not materially, modifies and enlarges the scope of the codes as usually drafted. The significant statement in the A.S.M.E. code, however, is that the engineer should consider the protection of clients' or employers' interests his first obligation and, therefore, avoid every act that could be considered as in any way contrary to his duty.

In contrast are the principles of professional practice of our professional brothers, the architects, which decree that the architect should not engage in, nor encourage, any practice contrary to law or hostile to the public interests, even under his client's instructions; for, as he is not obliged to accept a given piece of work, he cannot, by pleading that he has but followed his client's instructions, escape the condemnation attaching to his unethical or unlawful acts.

[1] Published in THE JOURNAL for May 1918, page 382.

[2] Washington Representative, U. S. Shipping Board, Emergency Fleet Corporation, Washington, D. C. Mem.Am.Soc.M.E.

The medical profession has for its prime object the service it can render to humanity. Reward or financial gain should be a subordinate consideration. In choosing this profession, an individual assumes an obligation to conduct himself in accord with its ideals. The following is from the code of the medical profession:

"Physicians should warn the public against the devices practiced and the false pretenses made by the charlatans, which may cause injury to health and loss of life"—a very emphatic statement. We find the same idea in the lawyers' code, which ends as follows: "Above all, a lawyer will find his highest honor in a deserved reputation for fidelity to private trust and to public duty as an honest man and as a patriotic and loyal citizen."

"Unfortunately," the author said, "my experience as an engineer and as a public official has given me the best of reasons for believing that this spirit is not representative of the engineering ethics of today."

High National Standards Depend on High Individual Standards

Bringing the matter onto a national basis, he said that recently in reading the life of John Fiske[1] he had found the following significant quotation relative to the moral principles of the Civil War:

> President Lincoln, by the summer of 1862, had come to see that the war as it had been conducted by the Administration had no clearly defined moral issue back of it, and that he could no longer find justification in continuing such a terrible conflict as he was waging against the people of the Southern States on the sole issue of an interpretation of the Constitution. He saw the necessity, for the salvation of the Nation, of getting the issue squarely on its merits as a moral issue—a conflict between the idea of freedom and the idea of slavery, and then uniting the moral and political forces of the North in support of this policy.
>
> To this end he moved on his own initiative; and one of the finest chapters in all statesmanship is the history of his skill, his patience, his wisdom, his faith in rousing the dominant moral feeling of the North and focussing it in support of his Proclamation of Emancipation.

Similarly, the speaker believed that the successful prosecution of the present war would be largely a question of our ability to keep it where President Wilson had placed it, namely, on high moral ground. This is not the work of one man, but of all the people. It is our work in all our relationships, whether they be those of town life, church life, or professional life. In this hour of real national peril, can we do less than write into our code that from this day forth it is unprofessional for an engineer to safeguard any private or special interest at the sacrifice of public welfare? Do we seek power, influence, prestige, opportunities? These and more will come when we provide for our profession this moral leadership.

Now is the Time for Code Revision

Fred J. Miller[2] (written). I think the actual attitude and practice of our members with regard to public service are far in advance of our code.

If American citizenship means anything, it means that no citizen can honorably take part in work that he knows to be against the public interest, and that principle applies to engineers, as well as to doctors, lawyers and architects.

Now, when so many are making sacrifices for the general good, not only of our own country but of the whole world, would seem to be the proper time to rewrite our code in the spirit of the times.

Richard A. Feiss[1] (written). Today every calling involves special knowledge and special training and the men pursuing these callings in the field or in the workshop must view their work as professional work; for each calling is today a profession. The majority, moreover, of these new professions are to be classified under the head of "engineering." The men pursuing them are by every right eligible to membership in the engineering societies. The vast majority of all these "engineering professions" are dealing more and more concretely and specifically with the handling of organized human effort. This involves social and other problems inherently of public interest.

We have all learned during the years of the war at least one thing—that no man or group of men are a law unto themselves. A man's rank or the rank of any association or group of men is no longer to be judged by the amount of worldly goods he may possess, or the amount of knowledge, or the accident of birth, but solely by the quantity and quality of service to the common good. It is therefore necessary that a society of professional men such as this take the leadership in making its prime object the setting up of standards for the profession and the development of a membership whose object is first of all the best service in both quality and quantity to the public interest.

H. J. Macintire[2] (written). We are living in an era of change. Ante-bellum conditions both in the material and spiritual world are probably gone forever and when the war ends we must face a period of reconstruction. In this new time about to dawn the heavy national debts will have to be assumed by the rich whose wealth will thus be depleted, while the increased wage of labor is automatically raising the material level of the mass of labor.

Standing between these two classes, materially speaking, is the professional man, who will have a chance such as he has never had before. Having maintained a position at neither of the extremes of society, he will be in a position for calmer judgments, for firmer progress. He will be called upon for leadership, but he can make his position enviable and assume this leadership deservedly only by such conduct as will command the esteem and confidence of the public and the respect of his fellow-engineers.

The engineer, in common with every person of education and sensibility, should be guided by the spirit of the law instead of by a slavish adherence to the letter. And surely it is not too much to ask that The American Society of Mechanical Engineers take the lead in demanding this broader ideal by so framing its code that every member of the society will be under pressure as a member (as well as an individual) to consider the interest of the community to be his greatest responsibility.

Suggestions for Code Revision

John B. Mayo[3] (written). I have read Mr. Cooke's paper and greatly admire its spirit. I find nothing to criticise and

[1] John Fiske, Life and Letters, by John Spencer Clark, vol. 1, p. 189.

[2] Major, Ordnance Reserve Corps, Ordnance Department, Rock Island Arsenal, Rock Island, Ill. Mem.Am.Soc.M.E.

[1] Gen. Mgr., The Joseph & Feiss Co., Cleveland, Ohio. Assoc. Am. Soc. M. E.

[2] Assistant Professor of Mechanical Engineering, University of Washington, Seattle, Wash.

[3] In Drafting Department, Electric Boat Company, Groton, Conn. Mem.Am.Soc.M.E.

cannot add to it except to remark that it has always seemed to me that the public interest might well be led up to by a reference to the description on the certificate which is framed and hangs in my hall and is signed by Eckley B. Coxe and reads thus:

"An organization for promoting acquisition of that knowledge which is necessary to the mechanical engineer to enable him most effectively to adapt the achievements of science and art to the use of mankind."

ROBERT J. HEARNE[1] (written). That the code of ethics of The American Society of Mechanical Engineers may need rewriting, is natural; but there is nothing in the code which is directly antagonistic to the consideration of the public welfare by an engineer. The code must be read as a whole.

Although one section states that "the engineer should consider the protection of a client's or employer's interest his first obligation," yet the preceding section says he must "be governed by principles of honor and honesty and should satisfy himself . . . that the enterprise . . . is of legitimate character, and if it is of questionable character he should sever his connection with it as soon as practicable, *avoiding in so doing reflections on his previous associates.*" (The italics are mine in this case, and are used to emphasize the last paragraph, which I think were better omitted.)

There are times for keeping silent, and there are times when one should speak out, and if a man is satisfied that his former associates are connected with a disreputable enterprise he should not keep silent, even if it hurts him to speak. It surely is unethical to keep silent when one knows of wrongdoing or incompetence.

It would be well, I think, to amend the section first referred to as follows:

> "The engineer should consider the protection of a client's or employer's interests his first obligation, and, therefore, should avoid every act contrary to his duty, *provided, however, that his client's or employer's interest does not infringe the rights of the public or any individual.*"

CHARLES M. HORTON[2] contributed an interesting discussion of the ethics of daily life, the distinction between right and wrong, and the influence of environment, training and the conditions of existence. The discussion does not bear abstracting and space, unfortunately, does not permit its use here in its entirety. Mr. Horton's conclusion, however is here quoted:

"So let us write our code. And let it begin with a phrase having to do with a broad, spiritual outlook upon life, with reference to our profession, and let it end with a kindred generous phrase. Let us not talk of things having to do with the 'unprofessional' and 'inconsistent' and 'undignified.' Let us forget that kind of admonition. We do not need it. What we do need, though, and which should be embodied in the code, is forceful language having to do with the spirit embodied in the phrase of 'live and let live'—the things which, after all, are necessary if life shall be worth the living, not physically but spiritually, and a living to all, for all. Let us not be negative. Let it be written what we shall do, not what we shall not do; the negative, through inference, will take care of itself—and woe unto him who disobeys and is found guilty. Such a code would be eminently practicable. Such a code we should write. We cannot do more; we certainly should not do less. Let us go big in this thing, and let the Society stand behind it to a man."

UNFAIR DEALINGS WITH THE GOVERNMENT DEPRECATED

C. WELLINGTON KOINER[1] (written). In times of peace the best interests of the Government are not considered very seriously. The principle of "every fellow for himself and the devil take the hindmost," is usually carried out to the letter. Special privilege is sought and obtained regardless of the effect on public interest; as an illustration, too many people take the stand that the Government must not be permitted to do anything aside from certain negative functions, as it were, especially if somebody is making money out of the things that the Government should do. The scandalous claims and setups for intangible values that have been made recently before the railroad commissions and other regulating bodies is another illustration of how far some lawyers and some engineers will go in opposition to the public interest and in violation of their code of ethics.

"All for the state and the state for all" means that her interest is to be considered first and at all times conserved, in order that we, as individuals, may, at all times, receive the maximum benefits from her protection.

I heartily subscribe to Mr. Cooke's sentiment that "every code now in use by engineers in this country and abroad should be entirely rewritten on much broader lines and in a more inspiring key."

THOMAS M. ROBERTS[2] (written). Business methods of long usage are in practice among engineers and contractors, and the custom of driving a sharp bargain is too often passed as legitimate. Such methods may be expected between man and man as long as ethical standards are held cheaply or of little value. But we may well consider their effect on our country and its Government during war, as well as the reflex action on the influence of engineers in public life.

It seems unfortunate that the Government in assembling war materials is repeatedly handicapped by the covert efforts of some engineer-contractors to insert in their specifications misleading phrases which to the Government officials seem correct, yet later result in considerable trouble and loss to the project in development. These men and their specified bids for public service cover the letter of the law, but they violate the ethical features of honest professional practice.

Mr. Roberts then cited specific instances of questionable practices in dealing with the Government in which the contractor inserted in his bid certain modifications of the original specifications which the Government was prevailed upon to accept and which became legal as soon as the bids were signed. Later, when the apparatus agreed upon was found inadequate, the Government was obliged to revert to the requirements of the specifications in order to secure satisfactory results, and had to pay the difference in cost between the device originally called for and the device offered in the bid.

"These examples," he wrote, "may not strictly be classed as acts of 'Aiding the Enemy,' but they represent a species of unethical dealings which no society of engineers or engineer-contractors should countenance.

"Let us emphasize this fundamental feature of our republic

[1] Secy-Treas., Durbrow & Hearne Mfg. Co., New York, N. Y. Mem. Am.Soc.M.E.

[2] Hadley, N. Y. Jun.Am.Soc.M.E.

[1] Gen. Mgr. and Engineer, Pasadena (Cal.) Municipal Light & Power Co. Mem.Am.Soc.M.E.

[2] Bureau of Yards and Docks, Navy Department, Washington, D. C. Mem.Am.Soc.M.E.

that a public interest is inseparably bound to the common welfare, and therefore every engineer and engineer-contractor in dealing with a public interest is bound by an ethical tie, which is paramount to the written law, and he should have a keen sense of justice toward the public commonweal."

CONDITIONS NOT AS BAD AS THEY SEEM

THORNTON LEWIS[1] (written). While it is true that the codes of ethics of the various organized engineering societies are sadly lacking in definite expression upon the obligation of engineers to the public interest, nevertheless my observation leads me to believe that engineers as a class fulfill their duty to the public just as faithfully as the men of the other professions such as doctors, lawyers, etc.

This is no reason, however, why our codes should not express the fact that public interest is the first duty. In fact, there are many positive reasons why they should do this. Among them may be mentioned the inspiration and stimulation to unselfish action which the younger men of our profession would and should receive from our codes. The very nature of our profession carries many of our members to wild or remote places where they necessarily are out of touch with any large body of engineers, and so have no opportunity for consultation as to the relation of engineers to the public. Definite standards of conduct and expressed ideals in our codes would be of inestimable value to them in their endeavors to hold true to the best that is in them and their profession.

Since engineers more and more are becoming dominating factors in public-service corporations and the manufacturing industries, can we not in reality bring around a better condition of society in general by helping them to see more clearly the path of duty to the public, which, in the long run, will be to the best interests of their corporations and to their best selves?

Our new codes of ethics must embody the thought that he who serves humanity most serves himself best.

A. F. NAGLE[2] (written). I regret to differ with the author, whom I believe to be actuated by sincere motives; nevertheless, I believe his paper is uncalled for.

That the founders of the Society were not indifferent to the ethical, or moral, character of its membership, is evidenced by the fact that they required a rigid search to be made by the Council into an applicant's experience and character, and if favorably acted upon, his name was to be submitted to a voting membership, consisting, at present, of over 8000, where but *two* negative votes would exclude him (see C 17). What an ordeal to go through! It is a wonder that any of us could pass through it. If, perchance, a bad man should slip in, he can at any time be expelled by a two-thirds vote of the Council (see C 25), hence one has to be not only a good man to get in but he has to remain good to stay in.

Mr. Cooke's plea that the public interest, be it city, state, nation, or humanity at large, should have paramount service from us, prompts me to ask what is implied. If our engineer be the sort of man we rightly assume him to be, he will deal faithfully with all his clients. What more can he do? I have been in the employ of cities, state and nation nearly one-half of my business life, and I can unhesitatingly say that the personnel of the engineers I have met in the public service have compared very favorably with those outside.

[1] Lewis, Robinson & Grant, Philadelphia, Pa.

[2] Elmira, N. Y. Mem.Am.Soc.M.E.

ENGINEERS AS LEGISLATORS

OBERLIN SMITH[1] said that while it is undoubtedly true that the engineering profession owes much to the public which has fostered and used its work, the statement regarding the duty of engineers to the public suggests, per contra, what duties the public owes to engineers. In this progressive age, with its enormous increase in efficiency due almost altogether to engineering inventions, why do we see our halls of Congress peopled with lawyers, merchants and farmers, not to say professional politicians, with scarcely an engineer in the whole conclave? The engineers, with their brethren, the architects and physicians, have not only collaborated in the building up of science and art, but of the good morals and the health and wealth of their communities. They certainly have a large share in the making of laws which tend to greater production, with greater efficiency, of the tools with which our civilization is builded.

As most of us do not have time to become practical politicians, we must depend upon our non-engineering friends to work gradually toward such a reform. This can only be done by the promotion of a proper enlightened sentiment among the mass of the people.

CORRECT ETHICS SHOULD BE TAUGHT THE STUDENT

CONSTRUCTOR JAMES REED, JR., U. S. N.[2] (written). The paper starts with the statement that "the members of our Society *individually* are doing everything in their power to help win the war" (italics are mine). We of the Government's permanent staff of engineers are tempted to elide that word "individually," or else add to it the words "and *collectively*," so magnificent has been the patriotic response to the Government's need on the part of the engineering societies and their members. Even in peace times we have believed we were a patriotic nation, but our patriotic duties did not embrace the broader view of what comprises real patriotism, namely, a consideration of the public interest always.

Judging from my own educational experiences at technical schools, there is at such schools an almost complete lack of emphasis placed on the importance of realization by engineers of the public interest.

I firmly believe here is the remedy: a thorough and constant teaching at our engineering schools of the higher ethics of the profession, the citizenship duty of the engineer, just as at our West Point and Annapolis the highest ideals of patriotism and loyalty are unceasingly held before the students.

I have never forgotten marching into section room one morning for recitation when a month-old "plebe" at Annapolis, and hearing the lieutenant instructor, standing erect before the class, say impressively, "Gentlemen—before you take your seats—you have read in the morning papers of the death of Lieutenant Philip Lansdale, U. S. N., killed in action in Samoa, and of Ensign Monahan, who refused to leave his wounded superior and fell while trying to clear a jammed Colt automatic to hold off the enemy. Always remember this act: in it are embodied all of the best traditions of our service!" I therefore offer the suggestion that a constant effort be made to hold before the student the importance of this realization in the practice of his profession, that the public interest is not to be forgotten or put aside for the benefit of the corporate interest.

[1] President and Engineer, Ferracute Machine Co., Bridgeton, N. J. Mem.Am.Soc.M.E.

[2] Mare Island Navy Yard, Vallejo, Cal. Mem.Am.Soc.M.E.

Resolution on Modification of Aims of the Society

L. P. Alford.[1] The discussion clearly calls for us to reframe our code of ethics. We ought to associate with that reframing the restatement of another provision of the Society, namely, the statement of the aims and objects expressed in our Constitution. They are quite narrow and technical, yet the tendency for the last few years has been to make the Society industrial rather than purely a society of mechanical engineering. We have broadened the activities of the Society beyond its statement of aims. The restatement of the code of ethics is to reframe for us the ideal of the duties of the engineer. When the revised draft of the code of ethics is presented there should also be presented a consistent revised draft of the objects and aims of the Society.

The following resolution was then introduced by Mr. Alford, and was carried by vote of the meeting:

Because of the interest aroused by the paper presented by Mr. Morris L. Cooke at the Worcester meeting, and because of the frequently expressed belief that the work and activities of The American Society of Mechanical Engineers have outgrown its statement of aims and objects, it is respectfully suggested to the Council of the Society that steps be taken to reformulate the objects and aims of the Society as presented in the Constitution, and to recast the Code of Ethics of The Society to bring these in keeping with the interests and activities of the Society as a whole.

Professional Ideals

Calvin W. Rice. I have been making the spirit of this paper a religion in my administration of the office of Secretary of the Society and welcome this opportunity to express my faith in the ideals of the engineering profession.

Mr. Cooke referred to the way in which President Lincoln aroused the dormant moral feeling of the North in the support of his proclamation of emancipation, and I want to point out that from the very fact that this feeling *was* dormant, it already existed in the minds and hearts of the people and needed merely to be aroused.

Mr. Cooke has also told how President Wilson, with great ability, sensed the ideals of the Nation in this time of the world war. In the same way as before, these ideals were already existent and needed only to be phrased; and I claim for the engineers of the country, as individuals and idealists in an ideal profession, that they have contributed their share to the state of opinion and to the ideals of the nation in this present war, such as the President has expressed.

As a concrete example of the point I am making, I have just returned from a trip to the Sections of the Society and stopped at Dayton, Ohio. There I found the magnificent new clubhouse of the Dayton Engineers' Club, donated to the engineers of that city by two members of our Society. It is of chaste architecture and is located on a beautiful site overlooking the river. What is more important than this, however, is the fact that the club, as stated in the literature which it issues, is dedicated to *the dissemination of truth* and to *the creation of civic righteousness.*

This is a cheering example of the new spirit of the Nation, which shows that in this case at least the engineering profession is alive to the spirit of the times.

I have made a study (see Appendix) of the stated objects of the scientific societies of the world: of the English societies, the Royal Society, the Institution of Civil Engineers, which is the oldest engineering society—it celebrated its one hundredth anniversary just a few months ago; the societies in France, the Academy as well as La Société, corresponding to our engineering society; the Italian societies; and the societies of America, including the National Academy of Sciences. It is no reflection upon our Society that it does not stand out preëminent above all the others in its stated objects, or that it falls behind our new national ideals. There is only one society and, strange to say, it is in Germany, that in its constitution approaches what we here aim to do. As nearly as I can remember the objects of the Verein Deutscher Ingenieure are twofold: devotion to the engineering profession, and to the development of engineering *for the benefit of the Fatherland.* Here, however, the one thing is lacking that we find lacking in the whole of Germany. There is no expression of the spirit—it is all for the state.

It is not sufficient that we have the objects of this Society and of our profession for the benefit alone of the United States of America. That would be far short of the goal. We must, as Dr. Hollis has exhorted us, reconsecrate ourselves to our new ideals, as displayed in the dedication of the Dayton Engineers' Club.

Mr. Rice then stated that he had noted in the public press that Mr. Isham Randolph, a former director of the American Society of Civil Engineers, had been e tended an invitation, either through Mr. Cooke or through some appropriate convention, to prepare a new code of ethics for our profession. He recommended that the Society should get in touch with Mr. Randolph so that he might include a statement applicable to mechanical engineers.

Later a motion was made and carried by the meeting requesting the Secretary to communicate with Mr. Randolph.

R. Sanford Riley,[1] speaking as the President of the Worcester Chamber of Commerce, as well as one of the older members of the Society, referred to the broadening conception of the engineering profession, and said that when he entered the profession he had not realized that engineers were as well qualified as others for service to their country. It is easy to criticise engineers because of the fact that Congress is filled with lawyers and others in lines of business different from our own; but it is largely our own fault. We are growing in numbers, and growing in importance. To grow proportionately in power we must be interested in larger affairs than our own. Worcester is important as a city largely because it is a city of engineers. They continue so large a proportion of the community that from necessity they have formed the habit of doing things in a public way—and the city has not lost anything in consequence.

The Author, in closing, called attention to a remarkable document, A Study in Hospital Efficiency, comprising a case report of the first five years of a private hospital, by E. A. Codman, M.D., 15 Pinckney St., Boston. The price of the report is $1. This report is remarkable because it analyzes with freedom and truthfulness every case treated and shows whether there were errors on the part of the surgeon through poor diagnosis or lack of technique; faults in nursing; faults on the part of the patient, etc. This was instanced by the author as an advanced step in professional ideals. The report also constitutes a strong condemnation of fee splitting, which so often leads to unnecessary surgery. The application to other professions is obvious.

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[1] Chief of Staff, *Industrial Management*, New York, N. Y. Mem.Am. Soc.M.E.

[1] President, Sanford Riley Stoker Co., Ltd., Worcester, Mass. Mem. Am.Soc.M.E. Supervisor Trial Trips, Emergency Fleet Corporation, Philadelphia, Pa.

APPENDIX [1]

OBJECTS OF PROFESSIONAL SOCIETIES CLASSIFIED

In examining the objects of some ninety of the largest and better-known professional societies, including professions other than engineering, both of the United States and abroad, the resemblances are found to be many. In the great majority of the societies the objects incline toward the advancement of their respective professions, the improvement of the professional standing of their members and the fostering of the social spirit within the various groups. Practically all agree as to the methods to be employed in attaining these objects—the establishment of society rooms, the holding of frequent meetings, both social and professional, the presentation of papers and the soliciting of discussion, with their publication and distribution to the membership through the medium of monthly journals or bulletins or yearly transactions.

A limited classification has been made to show in a very general way how the societies are grouped under certain headings. In most cases, of course, a society is mentioned in connection with two or three different objects, all of which it may desire to attain.

Perhaps the aim most frequently stated is the advancement of a particular science (usually incorporated in the name of the society) or in some cases of two or three of the allied sciences. Below is given in tabulated form the list of such societies with the wording used by them in this connection:

American Bar Association—to advance the science of jurisprudence
American Chemical Society—advancement of chemistry
American Electrochemical Society—advancement of the theory and practice of electrochemistry
American Institute of Accountants—to advance the science of accountancy
American Mathematical Society—to encourage and maintain an active interest in mathematical science
American Physical Society—advancement and diffusion of the knowledge of physics
American Political Science Association—encouragement of the scientific study of politics, public law, administration and diplomacy
American Water Works Association—the advance of knowledge of the design, construction, operation and management of water works
California Academy of Sciences—the promotion of science
Cleveland Engineering Society—the advancement of engineering, architecture and applied science
Chemists' Club of New York—the advancement of the science and application of chemistry
Clinical Society of London—cultivation and promotion of the study of practical medium and surgery
Franklin Institute of the State of Pennsylvania—the promotion and encouragement of manufactures and the mechanical and useful arts
Institution of Civil Engineers—promoting the acquisition of that species of knowledge which constitutes the profession of a civil engineer.
Institution of Mechanical Engineers—to promote the science and practice of mechanical construction
International Association of Municipal Electricians—the acquisition of knowledge relating to fire, telegraph, heat, light and power systems
Mineralogical Society—to advance the study of mineralogy, crystallography and petrology
National Fire Protection Association—to promote the science and improve the methods of fire protection and prevention
New York Academy of Medicine—investigation and promotion of the science and art of medicine
New England Water Works Association—advancement of knowledge relating to water works and water supply
North East Coast Institution of Engineers and Shipbuilders—the advancement of the sciences of engineering and shipbuilding
New York Electrical Society—dissemination of the knowledge of theoretical and applied electricity.
Oregon Society of Engineers—to advance the science of engineering and architecture
Philosophical Society of England—the furtherance of philosophy as a separate science
Surveyors' Institution—the acquisition of that knowledge which constitutes the profession of a surveyor
Western Association of Technical Chemists and Metallurgists—the general advancement of technical chemistry
Society of Mineral Industry—the progress of the mining and metallurgical arts
French Physical Society—the advance of physical science
International Society of Electricians—to promote the popularization and development of electricity
Swiss Society of Engineers and Architects—to encourage progress in architecture and mechanics

The promotion of the arts and sciences in connection with their respective lines of endeavor is another important end to be attained and the following societies have so worded this clause:

Aeronautical Society of America—the advancement of the theory and practice of aeronautics and of the allied arts and sciences
American Institute of Electrical Engineers—the advancement of the theory and practice of electrical engineering and of the allied arts and sciences
American Institute of Mining Engineers—to promote the arts and sciences in connection with the economic production of the useful minerals and metals
The American Society of Mechanical Engineers—to promote the arts and sciences in connection with engineering and mechanical construction
American Society of Refrigerating Engineers—to promote the arts and sciences connected with refrigerating engineering
Institute of Radio Engineers—the advancement of the theory and practice of radio engineering and of the allied arts and sciences
National Electric Light Association—activities shall be for the fullest development of the electrical engineering arts and sciences in all their branches
Society of Automotive Engineers—to promote the arts and sciences connected with the design and construction of automobiles, self-propelled or mechanically propelled mediums for the transportation of passengers or freight, and internal-combustion prime movers
United Engineering Society—to advance the engineering arts and sciences in all their branches
Institutio Polytechnico Brazileiro Escola Polytechnica—the study and diffusion of theoretical and practical knowledge of different branches of engineering and of the auxiliary sciences and arts

The advancement of engineering knowledge and practice is the statement in a general way of the aims of the following societies:

American Society of Civil Engineers—the advancement of engineering knowledge and practice
Engineers' Society of Northeastern Pennsylvania—the advancement of engineering knowledge and practice
Engineers' Society of Pennsylvania—the advancement of engineering in its several branches
Engineers' Society of Western Pennsylvania—the advancement of engineering in its several branches
Oregon Society of Engineers—to advance the science and practice of engineering
Society of Engineers of Eastern New York—the advancement of engineering in its several branches
Washington Society of Engineers—the advancement of engineering knowledge and practice
Western Australian Institution of Engineers—the advancement of engineering knowledge and practice
Western Society of Engineers—the advancement of the science of engineering

Another and very important purpose of a professional society is the maintenance of high professional standards. The methods of expressing this purpose are so nearly alike

[1] To accompany remarks of the Secretary.

that merely the names of those societies avowing it are given:

American Association of Engineers
American Bar Association
American Institute of Accountants
American Institute of Electrical Engineers
American Society of Civil Engineers
American Society of Engineering Contractors
American Society of Heating and Ventilating Engineers
Engineers' Society of Northeastern Pennsylvania
Engineers' Society of Pennsylvania
Engineers' Society of Western Pennsylvania
Florida Engineering Society
Institute of Radio Engineers
Mining and Metallurgical Society of America
Municipal Engineers of the City of New York
Oregon Society of Engineers
Society of Engineers of Eastern New York
Society of Municipal Engineers of the City of Philadelphia
Washington Society of Engineers
Western Australian Institution of Engineers
Swiss Society of Engineers and Architects

Either for social or professional reasons, and often for both, all societies desire to further intercourse among their members and they employ the same methods of meetings, publications and correspondence.

Research plays a large part in the aims of many, as the following enumeration shows:

American Association for the Advancement of Science—to give a stronger and more generous impulse and a more systematic direction to scientific inquiry
British Association for the Advancement of Science—to give a stronger impulse and a more systematic direction to scientific inquiry
Canadian Society of Civil Engineers—to encourage original investigation
Colorado Scientific Society—the promotion of scientific observation
Michigan Academy of Science—encouragement of research
National Academy of Sciences—to investigate, examine, experiment and report on any subject of science
New York Academy of Medicine—the investigation of the science and art of medicine
Rensselaer Society of Engineers—the encouragement of original scientific research
Royal Society of Canada—to aid researches
Belgian Royal Academy of Sciences—researches in the field of sciences and letters, in particular mathematics and physics
National Institute of Sciences and Arts—to perfect sciences and arts by constant research
International Society of Electricians—by means of money or instruments to promote work on research and scientific undertakings
Western Association of Technical Chemists and Metallurgists—to encourage research in the metallurgy of precious and rare metals

Certain societies are devoted either to the encouragement of research and inquiry in, or the material development of, certain sections of the country, as:

Missouri Historical Society—encouragement of historical research and inquiry, especially within the state of Missouri and the Mississippi Valley
Municipal Engineers of the City of New York—to further the material development of the City of New York
New York Historical Society—to discover, procure and preserve whatever may relate to the natural, civil, literary and ecclesiastical history of the United States in general and of the State of New York in particular
Society of Municipal Engineers of the City of Philadelphia—to further the material development of the City of Philadelphia

The note of service to the public is struck by a few societies and though doubtless all aim to do this, nevertheless the following think it wise to state so quite definitely:

American Institute of Architects—to make the profession of ever-increasing service to society
Institution of Mechanical Engineers—to give an impulse to inventions likely to be useful to members of the Institution and to the community at large
National Society for the Promotion of Industrial Education—to bring to public attention the importance of industrial education, to promote the establishment of institutions for industrial training
Oregon Society of Engineers—to organize engineering opinion in matters of public interest
Surveyors' Institution—to promote the general interests of the profession and to maintain and extend its usefulness for the public advantage
Society of Civil Engineers of France—to promote by the active assistance of its members, professional education among the workmen and foremen in the industries and shops
Royal Statistical Society—to collect, arrange, digest and publish facts illustrating the conditions and prospects of society in its material, social and moral relations

In a few of the societies' purposes there is a clause relating to the promoting of the interests of the members of the societies, for instance:

American Foundrymen's Association—the advancement of the interests of foundry operators
American Institute of Accountants—to safeguard the interests of public accountants
Michigan Electric Association—to foster and promote the common interests of its members
Mining Society of Nova Scotia—to mutually benefit and protect its members
French Society of Alumnae of the National School of Mines at Saint Etienne—to secure for each member a position in the industry

With many, libraries and their maintenance are considered of sufficient importance to be mentioned in the statement of their purposes, and here we have the following list:

American Institute of Mining Engineers
The American Society of Mechanical Engineers
California Academy of Sciences
Franklin Institute of the State of Pennsylvania
Insurance Society of New York
United Engineering Society

Employment of their members and the rendering of financial assistance, when possible, are other laudable motives displayed by the following societies:

French Society of Alumnae of the National School of Mines at Saint Etienne—to create an assistance fund permitting pecuniary assistance to those who may need it and to secure for each one of them a position in the industry
Society of Architects Holding Diplomas from the French Government—to come to the assistance of the members by granting pensions and financial assistance
Society of Civil Engineers of France—to search for and announce to its members vacant positions to which they might aspire and to assist temporarily within the limits of its resources those of its members who may be in need of such assistance

Two entirely different elements are introduced in connection with publicity and legislation and here we find:

American Association of Engineers—supervising proposed legislation affecting the engineering profession, and taking any action necessary or advisable to safeguard the profession's welfare; promulgating the Association's ideas through proper publicity
American Bar Association—to promote the administration of justice and uniformity of legislation throughout the union

The improvement of the professional education of their members is another aim expressed by the *American Institute of Accountants*, and by the *Insurance Society of New York*.

The *Mining and Metallurgical Society of America* has for one of its objects the conservation of mineral resources, while the *American Society of Engineering Contractors* stands for "the elimination of those practices and abuses that now exist in the engineering and contracting business."

REPORT OF THE COMMITTEE ON WEIGHTS AND MEASURES OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS[1]

TO THE COUNCIL OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS:

IN its study of the extent of use of the metric system, your committee secured copies of a report entitled, "The Metric System in Export Trade," made by Mr. F. A. Halsey to the American Institute of Weights and Measures, an organization having for its main objects the maintenance and improvement of the English system of weights and measures.

This report is based upon more than fourteen hundred answers to a questionnaire which was sent to several thousand manufacturing concerns in the United States, some or all of whose product is shipped to countries which are supposed to use the metric system.

It is the only instance which we have been able to find where an earnest and sincere effort has been made to get at the actual facts with respect to the use of the metric system in export trade from the United States. While a great deal has appeared in print on this subject, nearly all of it was based on conjecture or limited knowledge. This report, as stated, gives the actual facts reported by more than fourteen hundred manufacturers.

The information contained is of such great interest and value to all who are studying this question with a desire to get at the truth, that we feel that our Society would be rendering a real service if the essential facts of this report as deduced from the replies to the questionnaire were presented to the membership. Your committee, therefore, offers herewith a comprehensive abstract of this report which comprises a careful summary of the replies received and the conclusions to be drawn from them.

Respectfully submitted,

L. D. BURLINGAME, *Chairman*
E. M. HERR
F. A. HALSEY
J. SELLERS BANCROFT
A. L. DE LEEUW
Committee on Weights and Measures

IN view of the thoroughness of the inquiry, this report may fairly be regarded as a census of the use of the metric system in this country.

The inquiry took the form of a questionnaire, which was sent to the following lists of manufacturers:

1 Our own members, of whom many are exporters

2 The members of the American Manufacturers Export Association

3 Those included in a card list of exporting manufacturers compiled by the American Manufacturers Export Association.

The total number of those to whom questionnaires were sent exceeded 6000. No selections were made from these lists, the questionnaires being sent to every name upon them. The number of countable replies received was 1445.[2]

The promise of a copy of our report to each one who answered the questionnaire (see form letter below) brought many replies from those who added to their questionnaires that they did no export business, or that their export business was confined to English-speaking countries. Such questionnaires, having no significance, were not counted.[1]

A considerable number of replies were received, filled out in due and proper form, except that they were unsigned. Such questionnaires were not counted, except those unsigned questionnaires enclosed with signed letters or in envelopes carrying printed firm or corporate names and addresses.

A few replies were received from exporting merchants but, since it is physically impossible for a merchant to record on one sheet the practice in producing the numerous products in which he deals, such replies were not counted. This was foreseen and provided for in the first paragraph of the form letter, by which the inquiry was restricted to exporting manufacturers.

The questionnaire was sent out with the form letter and immediately follows it.

Dear Sirs:

In accordance with the purpose of the Constitution of this Institute to investigate the usage of weights and measures in their various applications, we enclose to you, and to a large number of exporting American manufacturers, a questionnaire intended to discover at first hand how much truth there may be in the assertion that this country should adopt the metric system if it expects to succeed in the cultivation of foreign markets.

Such an inquiry is obviously a necessary preliminary to the proper consideration of a change in our fundamental units of weight and measure, but, until now, no effort has been made in any quarter to conduct one. You will, we are sure, agree that it is a matter of first importance and we believe you will be glad to assist us by filling out and returning the blanks of the questionnaire.

This questionnaire represents but a small part of the investigations which we have in progress, and your coöperation is of even greater importance than here appears.

In order that you may retain a copy for your files in convenient form, the blanks are enclosed in duplicate.

When completed and published a copy of our report will be forwarded to all who show interest by supplying the asked for data.

Please answer whether you do or do not use the metric system. We want the facts on both sides.

FORM LETTER

_____, 1917.

American Institute of Weights and Measures,
20 Vesey Street, New York.

Gentlemen:

Referring to your inquiry regarding our experience with weights and measures in foreign trade, you will find that experience summarized below:

We have been engaged in foreign trade for ..... years.

Our line of products consists of .....

1. In our factory work, and in order to adapt our goods to the needs of buyers in metric countries, we have found it desirable to abandon English measures and use, instead, metric measures for the various dimensions of our products to the following extent:

Not at all	
Slightly	
Considerably	
Extensively	
Exclusively	

Make a cross in the appropriate square.

Exclusively is understood to mean the absence of all English

[1] Presented at the Spring Meeting, Worcester, Mass., June 1918, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. The report is here printed in abstract form. Copies of the complete report may be obtained in pamphlet form: price 15 cents to members; 30 cents to non-members.

[2] A list containing the names and addresses of the manufacturers who replied to the questionnaire and whose replies form the basis of this report may be obtained from the American Institute of Weights and Measures.

[1] From the standpoint of *export trade*, as distinguished from *export trade with metric countries*, these latter replies (which, of course, show no use of the metric system) should have been counted.

dimensions in the product—not a few metric dimensions in every shipment.

Remarks and Particulars

2. We have found it advisable to pack our goods for trade with metric countries in containers of metric dimensions or containing metric weights to the following extent:

Not at all	
Slightly	
Considerably	
Extensively	
Exclusively	

Make a cross in the appropriate square.

Remarks and Particulars

3. In our literature for and correspondence with metric countries, we have found it advisable to give information regarding weights, output, capacities, over all dimensions, etc., in metric terms as follows:

Not at all	
Slightly	
Considerably	
Extensively	
Exclusively	

Make a cross in the appropriate square.

Remarks and Particulars

Yours very truly,

THE QUESTIONNAIRE

CONFUSION BETWEEN THE FIRST AND SECOND QUESTIONS

The first questionnaires sent out were addressed *Manager Export Department*, but this was soon found to have been a mistake. Export departments are very familiar with shipping methods, but frequently they know little of factory practice, and their footnotes under Remarks and Particulars and accompanying letters showed that the two were frequently confused.

The object of the first and second questions was to discriminate between production and shipping methods. This is a distinction not of place but of kind, but in numerous cases it was ignored because, the packing and shipping being frequently done in the factory, they were regarded as part of the factory work. In such cases, the use of the system in shipments was made to give an answer for its use in production, and in other cases the giving of metric equivalents of English dimensions in catalogs and correspondence and even the giving of prices in metric terms were made the bases of replies showing the use of the system, in production, *so stated on the same sheets*. Some of these replies were naive in their simplicity, showing that those replying had no conception of the industrial uses of weight and measure other than shipping weights and price units.

This tendency to confuse shipping and commercial with factory methods was discovered after about 5 per cent of the questionnaires had been sent out, and thereafter they were addressed *Attention of Factory Superintendent* and, to make still plainer the distinction between the first and other questions, the following rubber-stamp impression was added to each outgoing questionnaire alongside the first question:[1]

This question relates EXCLUSIVELY to factory methods and measurements.

It has nothing to do with price units, sizes or weights of parcels or sales methods for which see other side.

[1] To further clear up any possible chance of misunderstanding in the replies, five other form letters were eventually sent out covering points which it was suspected that the writers had not fully understood.

INCOMPLETE ANSWERS

A considerable number of questionnaires were received in which but one or two answers were given. Examination showed that most of the answers given were in the affirmative; that is, they showed a greater or less use of the metric system. There is no reason why every return should not have included answers to all three questions. Every exporting manufacturer does or does not use the metric system in the three ways specified, and when replies were received, showing two affirmative answers with the other one blank, two explanations were possible. The first one was that the signer of the questionnaire had placed crosses for those uses of the system which he knew about and omitted the one with which he was not familiar, and the other was that the answers covered those cases in which the system is used, but passed over those in which it is not used, or, in other words, that in such cases no answer is equivalent to a negative answer.

The studiously non-partisan character of our form letters and questionnaire led many to believe that we are supporting the metric system, for which supposed activity we received both compliments and protests. But one letter of the opposite kind was received against many showing this impression, which led some to suppose we wanted only those replies that would support the metric propaganda.

Whatever the explanation, it was desirable to have the answers complete and another form letter was sent to many who failed to answer the first question.

THE FIRST QUESTION

In our factory work, and in order to adapt our goods to the needs of buyers in metric countries, we have found it desirable to abandon English measures and use, instead, metric measures for the various dimensions of our products to the following extent:

This question is by far the most important of the three. When a manufacturer makes his products to the millimeter to the exclusion of the inch, he has, in truth, adopted the metric system and until he does that, he has not adopted it. The giving of catalog information in metric terms is a use of the metric system, but a use exactly comparable with the use of the Spanish language in catalogs for Spanish America and is no more the adoption of the metric system than the printing of such catalogs is the adoption of the Spanish language.

The fact that the commercial use of weights and measures is before us in every business transaction of every-day life leads many to assume the commercial use to be of paramount importance, and, indeed, to ignore the factory use. When we reflect that, excepting some foodstuffs, substantially everything we buy is made before it is sold, that factory measurements largely outnumber (frequently 100 and sometimes 1000 to 1) those which appear in sales transactions, that commercial measurements are usually the roughest approximations while factory measurements are often of the highest degree of refinement by precision measuring instruments developed for that purpose, we find that the primary, important measurements of civilization are those made in the production of commodities.

Replies to the first question are summarized in Table 1.

NO USE OF THE METRIC SYSTEM IN PRODUCTION

The following extracts from letters make a suitable introduction to this phase of the subject.

The Addressograph Company (addressing machines, in export trade 12 years) write of only one request for goods to be

TABLE 1 SUMMARY OF REPLIES TO THE FIRST QUESTION

	Count of returns	Per cent
Not at all	1188	82.2
Slightly	160	11.2
Considerably	29	2.0
Extensively	16	1.1
Exclusively	6	0.4
No reply to this question	46	3.1
Total	1445	100.00

marked in the metric system in the past twelve years.

The Babcock Printing Press Mfg. Co. (printing machinery; in export trade 30 years) write:

We consider the proposition of changing our system of weights and measures to the metric system as no more necessary or desirable than teaching the men in our shop the language of the country in which the machine is to be run.

The Berger Mfg. Co. (sheet-metal products; in export trade for 15 years) write:

We find that customers [in metric countries] are invariably acquainted with our system and that they are able to make conversions into our weights and measures the same as we do when an inquiry comes to us in metric.

The Black-Clawson Company (paper-mill machinery; in export trade 25 years) write:

We have had no trouble whatever using English measures.

The Boston Pressed Metal Company (metal stampings; in export trade 10 years) write:

France, Russia, Argentine, Brazil, Denmark, Australia and Canada use regular stock of inch sizes.

The Bristol Patent Leather Company (in export trade 12 years) write:

The largest leather-producing countries use the square foot as their basis, therefore, the square foot is a familiar unit even in countries using the metric system.

F. W. Brody & Co. (cottonseed products, in export trade "many" years) who reply Not at All to all of our questions, add:

And our exports the past season were approximately $1,000,000.

The Brown Folding Machine Company (paper-folding machinery, in export trade 20 years) write:

We cannot recall any instance where we have been asked to give anything but United States standard weights and measures.

The Brown Portable Conveying Machinery Company (portable conveying machinery; in export trade 6 years) write:

The foreign buyer buys from our standard sizes nearest to his approximate metric requirements.

The Cleveland Automatic Machine Company (machine tools) write:

We rarely have occasion to make up specifications using the metric system for abroad. We ship a vast amount of material to foreign countries.

The Collins Company (cutting tools; in export trade 70 years) write:

Our business is nine-tenths with foreign countries. We have no need whatever to use the metric system in our business.

Curtis & Marble Machine Co. (cloth-finishing machinery; in export trade 40 years) write:

Where the goods are measured by the roll or drum system, we use the regular yard circumference drum and then use compensating gears to reduce this to meters. In the South American trade there are four or five different lengths used, none of them metric and each a specific measurement for individual countries.

The Benjamin Eastwood Company (textile machinery) write:

There is no call for the metric system of weights and measures in building textile machinery for export.

The Chase Turbine Manufacturing Company (woodworking machinery; in export trade 40 years) write:

One customer has a scale attached to the machine to indicate width of opening. This scale is graduated according to the metric system.

The William J. Dines, Jr., Company (plantation machinery; in export trade 6 years) write:

When we receive orders for machinery, it is usual to receive a sketch showing the proposed installation and the dimensions are more often given in feet and inches than in the metric measures even from countries using the metric system.

The Dodge Steel Pulley Corporation (steel pulleys; in export trade 17 years) report exclusive use of English dimensions.

Eastman, Gardiner & Co. (building lumber; in export trade 12 years) write:

Last year we took up the matter with our agents in France, Belgium, Italy and England. They stated that although the metric system was used in some of the above countries, that in lumber, the buyers were so accustomed to using the English measure that it would be a great mistake to make any change in our method of figuring.

Fairbanks, Morse & Co. write:

We have been actively engaged in developing foreign trade for the past 15 years, and our experience touches practically every country in the world. The lines of goods that we manufacture and sell abroad are quite varied, embracing internal-combustion engines, steam, power, and centrifugal pumps, electrical dynamos and motors, railway supplies and windmills.

We are, of course, sending our goods to countries where the metric system is used, but we have not seen any necessity whatever for abandoning the English standard of weights and measures.

The Faweus Machine Company (gears and gear drives; in export trade 16 years) write:

On one occasion we made some special machinery to drawings furnished by a customer in Spain on which metric dimensions were used. We readily transcribed them into English.

The Glasgow Iron Company (steel and iron plates, etc.) write:

Orders for our product come to us in feet and inches, and are so marked when shipped.

The R. P. Hazzard Company (men's shoes; in export trade 10 years) write:

We have never had called to our attention any metric system for designating sizes of boots and shoes.

The National Radiator Company (steam radiators, boilers and fittings) write:

Our foreign customers have taken our products just as we manufacture them for domestic trade.

The Penn Engineering Company (steam and water specialties, in export trade 18 years) write:

We have never used anything except English measures, nor found any need to change them at any time.

The Russell, Burdsall & Ward Bolt & Nut Co. (bolts, nuts, rivets and washers; in export trade 20 years) write:

We ship our goods to almost every country throughout the world and find that the English weights, measures, etc., are generally satisfactory.

William Sellers & Co. (machine tools and power-transmission machinery; in export trade 60 years) write:

Notwithstanding the large volume of foreign inquiry we receive, so little of it calls for adherence to the metric system as to be practically negligible.

The Walter A. Wood Mowing and Reaping Machine Company, who reply Not at All to all of our questions, say:

We do a large export trade in Scandinavia, France, Germany, Russia, Austria-Hungary and Roumania.

MANUFACTURERS WHO REPLIED THAT METRIC MEASURES WERE UNNECESSARY FOR THEIR PRODUCTS

Representatives of some 570 different industries replied to the first question regarding the use of the metric system in the production of their goods for export by placing their crosses in the Not at All line.[1]

From the large number of chemical industries reporting it is seen that manufacturing, as distinguished from laboratory work, chemistry is conducted on the English system. The numerous electrical industries which follow the English system show that the prevailing impression that the electrical is a metric industry is unfounded.

Many of the industries from which replies were received, such as chemicals, agricultural machinery, mining machinery, etc., produce not one, but great lines of products. Such industries, however, are considered as single items, the number referring not to products, but to industries.

PARTIAL USE OF THE METRIC SYSTEM IN PRODUCTION

The reports of partial use are, in some respects, the most instructive of all. From them, we learn that it is only in rare cases that the units of measure used in the production of a commodity have anything to do with its salability in any market, the calls for the metric system being always special and of no general application or significance.

For example, in substantially all lines of machinery, foreign purchasers of automobiles, electrical, mining, ice-making, agricultural machinery, etc., care no more about the units to which the parts of these machines are made than the reader cares about the English or metric units used in the construction of his own watch. The only exception to this law is found in about one-third of the reports for machine tools. Here the metric features called for are those few immediately concerned in measuring the products made on the machine.

Again, in the case of chemicals, it must be clear that the units used in the productions of the goods have nothing to do with the salability of the products. In steel and iron products—structural material, pipe, etc.—the preponderance of English-speaking countries in the production of these goods has made their products the standard of the world as is true, also, of automobile tires; while in textiles a letter of the American Printing Company saying that "practically all of our goods for export trade are measured in yards," shows the extent to which the yard is used as a price unit in the metric countries.

The most striking illustration is found in weighing and measuring instruments designed for weighing in metric units. In these instruments the construction remains strictly English, the only metric feature being the graduated dial or scale by which the indications are read; and in the case of recording instruments, these graduations are placed on ruled sheets of paper which are not even parts of the instruments.

Representatives of the following industries reply to the first question by placing their crosses in the Slightly, Considerably or Exclusively lines as indicated by the figures in parentheses.

Automobiles and automobile trucks: Not at all (22), Slightly (20), Considerably (2).

The use of the metric system in the automobile and automobile-truck industry to meet the needs of export trade is limited to speedometers, spark plugs, tires and wheel rims to suit the tires. Speedometers are graduated to read in kilometers just as, for Russia, they are graduated to read in versts. In both cases, we give the customer what he wants and one practice has as much and as little significance as the other.

It will be observed that most of the automobile companies who use the metric system at all place their crosses against Slightly for the use of the metric system for these items. The extent of this use is shown by the following extracts from letters.

The Cadillac Motor Car Company say:

Until a year ago millimeter-sized wheels and tires were shipped with cars to Australia, but our distributor there changed to inch sizes. Most South American countries take inch sizes, with the exception of Chile, which takes millimeter.

The Paige-Detroit Motor Car Company say:

At the present time, the demand for metric wheels, rims and tires is extremely limited. Since the first of the year, we have only shipped 6 cars so equipped.

The Dart Motor Car Company, Dodge Brothers, the Elwell-Parker Company, the Ford Motor Company, International Motor Company, Lexington Motor Company, and the Maxwell Motor Sales Corporation, all report the use of American-size tires in their trade.

Metric spark plugs are so called because of the metric screw thread by which they are secured in place, all their other dimensions being English. Such plugs, however, are not universal in metric countries. The Cole Motor Car Company say in reference to export trade:

We use the 7/8—18 S.A.E. standard spark plug.

The J. B. Crockett Company say:

The percentage of metric spark plugs against those of standard thread as used by ourselves which are exported is about two-thirds metric—the balance, 1/2, 1/2 inch and 7/8 inch, that is, omitting the regular Champion X Ford plugs. The greater portion of Ford spark plugs shipped into foreign countries are the same as the regular standard American used here.

The Paige-Detroit Motor Car Company say that requests for the metric spark plug are practically obsolete at present, and Dodge Brothers report annual shipments valued at $1,000,000 to metric countries, but all cars are furnished with standard English spark plugs.

Automobile crankshafts: Slightly (1). The Automobile Crankshaft Corporation (in export trade three years) who make this report, say:

About 60 per cent of crankshafts we are making for export are in English measurements, 20 per cent in English and metric (that is, some dimensions English and some metric) and 20 per cent in metric only.

Athletic goods: Not at all (1), Slightly (1).

Agricultural machinery: Not at all (9), Considerably (1), Slightly (1).

Abrasives and sharpening stones: Not at all (3), Slightly (1).

Ammunition: Not at all (1), Extensively (2).

[1] A list of the industries and the replies received in each is given in the complete report.

Belting: Not at all (2), Slightly (4), Considerably (1), Extensively (1).

The Rossendale-Reddaway Belting and Hose Company who report Extensively, say:

> We do not use it at all as far as the actual manufacturing is concerned. We do, however, receive many inquiries and orders from other countries in which they request length, breadth and thickness of belting according to the metric system, and in filling the orders, we supply them with the nearest measurements we have in feet and inches.

Brass and copper goods: Not at all (6), Slightly (2), Extensively (1). The Bridgeport Brass Company (in export trade 25 years), who report Slightly, say:

> We have furnished during the last two or three years large quantities of brass disks for the manufacture of cartridge cases, the dimensions of which were specified in metric units. These metric units we simply translate into the corresponding English equivalents and proceeded with the order. We have made seamless tubes in a similar manner and several million copper bands for shrapnel.

Bolts, nuts and rivets: Not at all (4), Slightly (3). Boiler tubes: Not at all (1), Considerably (1). Ball bearings: Not at all (1), Slightly (1). Balls: Not at all (2), Considerably (1).

Brick: Slightly (1). Boiler tube cleaners: Considerably (1). The William B. Pierce Company (in export trade 19 years), who make this last report, say:

> In countries using the metric system we merely use that system for turning and measuring the outside diameter of the machine.

Boat oars, hardwood dimension stock, etc.: Slightly (1).

Cutting tools: Not at all (14), Slightly (4), Considerably (5). The Cleveland Twist Drill Company (in export trade 30 years) who report Considerably, say that to France, Sweden, Italy and Spain their shipments are 90 per cent to 100 per cent metric. Shipments to Norway, Holland, Denmark and Russia are about 50 per cent English and 50 per cent metric. Shipments to Japan are about 90 per cent English and 10 per cent metric. Shipments to Central and South America are 95 per cent to 100 per cent English.

There are two types of cutting tools—those which by their own size determine the size of the work done by them (twist drills, reamers, taps, dies, milling cutters for gear teeth, etc.) and those which do not (most mechanics' hand tools). The replies showing the use of the metric system relate to the former type in all cases.

The remarks under weighing and measuring instruments below apply here almost without change. Sizing tools of millimeter dimensions are not made for use at home, but to sell for use abroad.

In 1916 a report on The Metric System in Export Trade was issued from the Bureau of Standards. Of thirty-three pages of illustrations of American metric products, twenty-seven show weighing and measuring instruments and sizing-cutting tools made for sale and use abroad, while three of the remaining six illustrations show lathes so arranged that others may cut metric screws when necessary, but every one of them fitted for cutting English screws as a primary function with makeshift translating gears to make possible the cutting of metric screws.

To those who do not understand, the illustrations make an impressive showing of the progress of the metric system; to those who do understand, they make an equally impressive showing to the contrary.

Many of these tools and instruments are of American invention. Metric countries learn of their merit and call for them. We adapt them to the needs of such customers by suitably spacing and numbering the divisions by which their indications are read.

Chemicals: Not at all (19), Slightly (1), Extensively (1). Chemical machinery: Extensively (1). The Werner & Pfleiderer Co., who report Extensively, say:

> When originally starting here in this country, we took over a number of patterns and drawings in metric which we have used ever since.

Corsets: Not at all (1), Slightly (2), Considerably (1). Car wheels, chilled rolls, and roll-grinding machines: Not at all (2), Slightly (1). The Lobdell Car Wheel Company (in export trade nearly 50 years) who make this last report, say:

> We occasionally get orders for chilled rolls for calendering paper to go abroad and the dimensions of the journals and necks are sometimes specified in millimeters. We have also had orders for a few wheels and axles with the metric sizes specified for the axle and hub dimensions.

Cotton duck: Not at all (2), Slightly (1). The Elm City Cotton Mills (in export trade 10 years) who make this last report, say:

> We have shipped quite a bit of cotton duck to Cuba and there have been a few instances where they have asked for metric measurements. For the last few years probably 95 per cent of the shipments we have made have been billed and branded with the usual English measurements.

Clay-working machinery: Not at all (1), Slightly (1). The American Clay Machinery Company (in export trade 37 years), who make this last report, say that this use of the system refers only to dies and molds used in presses and other machines for making clay goods.

Candles, stearine, glycerine, etc.: Not at all (1), Slightly (1).

Drop forgings: Not at all (1), Slightly (2). The Armstrong Brothers Tool Company and the Billings & Spencer Co. who both report Slightly, say that this use of the system refers only to "openings in machine wrenches."

Electrical machinery: Not at all (14), Slightly (1). The Westinghouse Electric and Manufacturing Company (in export trade 20 years), who make this last report, say that metric requirements are given in only a small fraction of the business taken—too small to state in figures.

Elevators, escalators, conveying and hoisting machinery: Not at all (8), Slightly (1). Explosives: Not at all (1), Slightly (1). Electrical wires, cables and accessories: Extensively (1).

Firearms, sporting: Not at all (4), Considerably (1). The A. H. Fox Gun Company (in export trade 5 years), who make this last report, say:

> About half of our foreign orders are received with the dimensions of the guns in the metric system.

Firearms, military: Not at all (2), Slightly (1). Fireclay products: Slightly (1).

Filters: Not at all (2), Slightly (1).

Glass, including plate, window, jars and bottles: Not at all (8), Slightly (2).

Ground-steel shafting: Slightly (1). The Cumberland Steel Company (in export trade 20 years), who make this report, say:

> We do not think we have finished any metric sizes for two or three years, and the quantity we made at any time is very small—hardly worth considering.

Grinding wheels: Not at all (4), Slightly (1), Extensively

(1). The Abrasive Company (in export trade 17 years) who report Slightly, say:

The grinding wheels that we supply to countries using metric measure are according to English and metric measures. It would be difficult to give an approximate idea of the percentage of the two kinds of measurements used, but perhaps we would not be far wrong in specifying 3 per cent metric and 97 per cent English.

The Hampden Corundum Wheel Company (in export trade 32 years) say:

Customers frequently order in metric specifications, but we supply the nearest English equivalents to their entire satisfaction.

Gas, gasoline, and oil engines: Not at all (12), Slightly (1). Gas-engine specialties: Slightly (1). The Kokomo Electric Company (in export trade seven years) who make this last report, say:

Only in one article—a metric thread spark plug.

Hoisting machinery: Not at all (2), Slightly (1).

Hammers: Slightly (1). Fayette R. Plumb, Inc. (in export trade 30 years), says:

The only cases are a certain pattern of carpenters' hammer and a certain pattern of sledge hammer used in South America.

Handles for hand tools: Not at all (2), Slightly (1).

The Turner, Day & Woolworth Handle Co. (in export trade 30 years), who make this last report, say:

Under normal conditions, shipments to those countries in which millimeter measurements are used will run about 25 per cent against 75 per cent on which inches are used.

Ice machinery: Not at all (4), Slightly (1). The Vilter Mfg. Co. (in export trade 30 years), who make this last report, say:

We do not think we ever made any of our compressors to millimeter sizes, but have made pipes, fittings, etc., at times. [The ice machine is, essentially, a gas compressor.]

Insulated electric wire and cables: Slightly (1).

Ingot metals: Slightly (1).

Knit goods: Not at all (2), Slightly (1).

Locomotives: Not at all (1), Slightly (2), Considerably (1). The Davenport Locomotive Works (in export trade 10 years) who report Slightly, say:

Only for track gage of locomotives.

Leather goods: Not at all (1), Slightly (1). Lubricators: Not at all (4), Slightly (1). The Richards & Phoenix Co. (in export trade 6 years), who make this last report, say:

Whitworth pipe threads are usually called for.

Machine tools: Not at all (60), Slightly (32), Considerably (3).

Machine tools are the machines with which machine shops are equipped. On them all other machines of whatever kind and for whatever purpose are made and the dimensions of their parts determined. Here, if anywhere, the need of the adoption of the metric system in export trade would be imperative and the returns from this industry are hence the most instructive of all.

The returns show the greatest use of the metric system to be in this industry and it is in this industry that The American Institute of Weights and Measures had its origin and has today among its members the greatest number of representatives, which is to say that those who have had the most experience with the system are also those who have organized to resist its further extension.

Some types of machine tool are fitted with attachments for indicating sizes and adjustments, and some are not. Such attachments, like weighing and measuring instruments for metric countries, are made to read in millimeters and frequently the graduations of these attachments are the only metric features of the machines. Thus we have drilling machines with indicators for the depth of the hole drilled reading in millimeters, but with no change in the machines. Since the circumferential speed of the cutting tools is an important thing to know, we also have cases in which tables are attached to the machines showing the speeds of different-sized drills at different rates of revolutions per minute in meters per second instead of feet per minute. We also have milling machines in which adjustments are made through the use of screws and graduated dials. In order that the indications may be made in millimeters, the screws (three in number) are cut to metric pitches and the dials graduated to read in millimeters with no other change in the machine.

Of a special class are lathes because of their important function in cutting screws, and this function has been a storm center of this controversy from the beginning. For this purpose lathes are fitted with lead, guide or master screws from which screws of other pitches are cut by the aid of combination or change gears.

How few metric countries call for any metric features of machine tools is shown by the following remarks by machine-tool builders. Except for lead and adjusting screws, which a few metric countries call for on some machines, the requirements are insignificant. About two-thirds of the replies show no metric features whatever to be asked for.

The Automatic Machine Company (automatic threading lathes; in export trade 12 years) say:

We furnish the various countries of Europe with our standard lead screw with the exception of France, Spain and Italy, to which three countries we furnish the lathes with metric lead screws.

Baker Brothers (keyway-cutting machines; in export trade 20 years) say:

We furnish some cutting tools in metric widths for keyseats, but the majority are furnished in English measurements even for metric countries.

The E. W. Bliss Company (metal-working machinery; in export trade 40 years) say:

We do not often find it necessary to make any part of our machines to metric measurements. Occasionally, some part, where tools already existing must fit, is required to be made to dimensions in millimeters.

The Cincinnati-Bickford Tool Company (drilling machines; in export trade "many" years) say:

We use metric speed and feed plates and give metric graduations on spindle sleeves or dial depth gages.

The Cincinnati Gear Cutting Machinery Co. (gear-cutting machines; in export trade 9 years) say:

For European countries we furnish a metric elevating screw for the work arbor and cutter arbor of metric diameter. All other dimensions are English.

The Cincinnati Milling Machine Company (milling machines; in export trade 20 years) say:

This applies to the feed screws which, for metric countries, are made so that the dial reads in millimeters instead of thousandths of an inch.

The Detrick & Harvey Machine Co. (planers, horizontal boring machines, gun lathes, etc.; in export trade 25 years) say:

Only in the matter of furnishing metric reading scales on certain machines. We have sold machinery in England, France, Germany,

Russia, Italy, Holland, Norway, Japan, South Africa, Chile, and other foreign countries.

The Gleason Works (gear-cutting machinery) say:

The only use we make of metric dimensions in our work is when we manufacture adjusting screws to metric standards to be used in conjunction with metric scales which show relative movements of parts of the machines.

The Lees-Bradner Company, Lodge & Shipley Machine Tool Co., The Kempsmith Manufacturing Company and the Springfield Machine Tool Company all report the use of metric units only in parts of articles for export to France.

The Norton Grinding Company (cylindrical grinding machines; in export trade 16 years) say:

There are four small parts of our grinding machines that we make to metric measurements for a few customers in some European countries.

The Rockford Drilling Machine Company (drilling machines; in export trade 17 years) say:

Metric dimensions are stamped on drilling-machine quills on machines for certain foreign countries.

Shortly after the beginning of the great war the *American Machinist* sent a commissioner (Mr. O. P. Hood) to South America. Mr. Hood's papers show that in the machine shops of South America—of which there are more than most people realize—39.3 per cent of the machine tools are American, 43.2 per cent are British and the remaining 17.5 per cent are German, Belgian and French. While South American shops have the world from which to buy, they choose machine tools made to English over those made to metric measures in the ratio of nearly 5 to 1.

Mechanical presses: Not at all (2), Slightly (1).

Magnetos: Not at all (1), Slightly (1). Machinery and equipment pertaining to the meat industry: Slightly (1).

Optical goods: Not at all (5), Slightly (2), Considerably (2), Extensively (1).

The use of the metric system in optical work applies only to the grinding of lenses, the mechanical parts of cameras, microscopes, etc., being made to the English system. This system was not adopted for the benefit of export trade, as is shown by the following from the Eastman Kodak Company:

It is customary in this work to use the metric system of measurement, probably because the practice in U. S. A. followed foreign practice where lens optics were first perfected.

Lens manufacture is one of many examples of the manner in which an industry, when transferred from one country to another, carries with it the units of measurement on which it was developed.

Another illustration is found in shoe machinery. The United Shoe Machinery Company write:

Our company established factories in England, France, Germany and Austria, and have exported goods and maintained subsidiary companies or branch offices in practically all of the countries of South America.

In order to maintain uniformity in such machines as we manufacture both at home and abroad, the English system of measurements is used in all countries so that if necessary machines and parts may be supplied from one country to another.

Another illustration is found in machinery and appliances for the chemical trade, regarding which the Werner and Pfleiderer Company write:

When originally starting here in this country, we took over a number of patterns and drawings in metric which we have used ever since.

Again, the Whitehead torpedo carried the English inch from England to Austria; as, again, steel balls carried it from the United States to Germany. The methods of wholesale precision manufacture of balls were developed in this country and taken to Germany where the customary practice today is to make steel balls to inch dimensions—German formulæ for the carrying capacity of ball bearings containing a factor for the diameter of the balls in English inches.

In the manufacture of silk fabrics, among Western nations France early gained the leading position and, as a result, the French system of numbering silk based on the denier (a weight) and the aune (a unit of length) became not only the silk standard of France, but of all countries, and is today the world standard for silk. In like manner, the early dominance of England in the cotton trade has made the English system of numbering cotton yarn based on the yard and pound the standard of the world, the only exception being France.

Equally striking is the establishment as world standards of the English standards for numbering linen and jute yarn.

But the most impressive example of the spread of standards of measurement as a result of industrial development is presented by Russia, whose system of linear measurements is based on the English inch and foot as a result of the visit of Peter the Great to England about 1701. The Russian duim is the English inch; the Russian foot is the English foot; the arshine is 28 inches; the sagene is 7, and the verst is 3500 English feet. All these are standards that will survive revolutions and invasions and are, with the language, the most stable of the country's institutions.

Oil-mill machinery: Slightly (1).

Oilless bearings: Slightly (1).

Oxygen apparatus: Extensively (1).

Power-transmission machinery: Not at all (8), Slightly (3). The Dodge Manufacturing Company (in export trade for 25 years) who make one of these reports, say:

Probably 99 per cent of our export production is made on English measurements and weights—that is, inches, feet and pounds.

The Standard Pressed Steel Company (in export trade 10 to 12 years) find it necessary to babbitt the bearings in the shaft hangers to a diameter corresponding to shafting of millimeter diameter in use in some foreign countries.

Perforated metals: Slightly (3). The Harrington and King Perforating Company (in export trade "many" years), say:

On receipt of an order it (the metric system) is changed to the English system and thus put through the factory with a few exceptions. We often use the metric system for specifying the size of perforations in our own factory and to both foreign and domestic customers.

Pipe: Not at all (8), Extensively (1). In this case, cast-iron pipe. Platinum: Extensively (1). Paper: Not at all (13), Considerably (1), Extensively (1).

Picture frames and moldings: Not at all (2), Slightly (1).

The Indiana Moulding and Frame Company, who make the last report, say:

Very few orders received requiring lengths or sizes in meters.

Piping: Not at all (1), Slightly (1).

Rubber goods, including automobile tires, hose, etc.: Not at all (11), Slightly (9), Considerably (2), Extensively (1). The practice regarding automobile tires is given above under automobiles. The Boston Woven Hose and Rubber Company (in export trade 30 years), who report Slightly, say:

The manufacture of hose for countries using the metric system is identical with the process used for hose consumed in this country with the single exception that the hose is made of a definite number of meters long instead of feet.

The Electric Hose and Rubber Company (in export trade 12 years) report that about 2 per cent they export to metric countries are made to millimeters and the balance to English sizes.

The Goodyear Tire and Rubber Company who have been widely heralded as having "adopted" the metric system, say:

> We are shipping tires made in both English and metric sizes to countries using the metric system. We estimate that somewhat less than 20 per cent of our total tire exports are made up of metric sizes. In addition, we are actually making partial use of the metric system in manufacturing practice.

Railway material: Not at all (2), Slightly (2).

Seamless steel tubing: Not at all (1), Slightly (2). The Elwood Ivins Tube Works (in export trade 20 years or more), who make one of these reports, say:

> When any person orders tubing made by metric measure, we immediately translate it in decimals of an inch. We never bill our tubes in metric measure, billing them in decimals of an inch. It is not by any means frequent that we get orders by metric measure.

Steel and iron products: Not at all (1), Slightly (1), Considerably (2). Shackle bolts and auto accessories: Slightly (1). The Bowen Mfg. Co. (in export trade 22 years), who make this report, say:

> On one occasion we had to make a lot of spring-shackle bolts having a metric thread at one end.

Sugar machinery: Not at all (8), Slightly (2). The Joubert & Goslin Machine and Foundry Co. (in export trade 12 years), who make one of these reports, say:

> The only time that we are called upon to follow metric dimensions is where we furnish some repair parts or make some addition to a machine built in Europe.

Scientific instruments: Not at all (2), Slightly (1), Extensively (1). The Brown Instrument Company say:

> We build instruments [pyrometers] using both the fahrenheit and the centigrade scales. In this country probably one out of every hundred orders calls for the centigrade range.

Semi-rare ores and their products: Slightly (1).

Steam and plumbing supplies: Not at all (4), Slightly (1). The John Simmons Company (in export trade 27 years) say:

> Lengths of pipe in meters for some countries.

Safety fuse: Slightly (1). The Ensign Bickford Company (in export trade 50 years), who make this report, say:

> For export to South America and certain other countries, we are often required to measure the length of the fuse as well as given dimensions and weights in metric units.

Shirts and collars: Not at all (2), Slightly (1). Surgical, dental and hospital equipment and supplies: Not at all (7), Slightly (1). Spark plugs: Not at all (1), Considerably (1). The New York & Brooklyn Auto Supply Co. say:

> According to our experience 50 per cent are shipped in metric thread and the balance in American threads.

Textile machinery: Not at all (9), Slightly (1). J. E. Windle (in export trade "several" years) says:

> We have had to make measuring dials register in metric measure on several machines we have exported the past few years.

Tractors: Not at all (4), Slightly (1). The Knox Motors Company (in export trade three years) say:

> Metric-sized spark plugs are used in our cylinders on export shipments, also metric measure is used in some ball bearings.

Transmissions for marine explosive engines Slightly (1).

Tobacco: Not at all (7), Slightly (1).

Textiles: Not at all (13), Considerably (1).

Stay bolts: Slightly (1).

Tool holders: Slightly (1). The Western Tool and Manufacturing Company (in export trade 10 years) say that this refers to threading tools only.

Vulcanized fiber, Extensively (1).

Watches and watch cases: Not at all (5), Extensively (2).

The metric system was not originally applied to American watch manufacture for the benefit of export trade, but because it was believed to be better adapted to the industry. The pioneer American (the Waltham) works adopted it at an early date and have continued it. Later, the Waterbury (now the Ingersoll) Works were fitted out by men from the Waltham Works who took the metric system with them, but all other American watch works conduct their operations on the English system.

A parallel example is found in steam-boiler injectors. This industry was imported from France by William Sellers & Co., who adopted and have continued the use of the metric system, but no competitor has followed their example, all other injector factories being conducted on the English system.

Another example is found in card-indexing and filing systems. The pioneer in this industry—The Library Bureau—was founded by Mr. Melville Dewey, who was a metric enthusiast and therefore adopted the metric system at the beginning. Competitors failed to follow the example of the Library Bureau, and that company has now abandoned the system.

The Library Bureau say:

> Some years ago all attempt at working to metric sizes and bringing out new cases was abandoned and the old lines were duplicated with full dimensions.
>
> Our draftsmen and mechanics failed to make any attempt to familiarize themselves with the metric system, but simply translated the metric dimensions into English inches or fractions thereof, and worked accordingly. I do recall, however, having known one man connected with Library Bureau in former days who was inclined to brag that he had mastered the metric system sufficiently so that he could actually think in it as well as he could in feet and inches, but I take it that his was a very rare case.

A fourth example is found in magnetos. The Eriesson Mfg. Co., who manufacture the Berling magneto, write:

> As a matter of fact, 10 years ago we used the metric measures in this plant exclusively, but owing to inability to get American mechanics who could use the metric system, we found it necessary to shift to the English measures and they are now used exclusively by us both for our product for domestic and export manufacture.

A fifth example is found in the chemical industry of the Solvay Process Company, of which the drawings used in the construction of the first plant came from Belgium and were in the metric system. These units were abandoned for lack of workmen educated to use them. It should be added, however, that the Solvay Process Company have continued to use metric measures of weight and capacity.

Here are five examples of the attempted adoption of the metric system under the most favorable possible conditions, namely, at the beginning of an industry. In two of these cases, it has been abandoned outright, and in the third, abandoned for measures of length.[1] In the other two cases, it has been continued in the factories where it was introduced, but it has not spread to other factories which followed them in point of time.

Moreover, those who continue to use the system because they have established an industry upon it and find the same difficulty in changing from it that they would in changing from the English system, do not find the anticipated advantages.

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[1] It is well known that the great difficulty of the change centers about the unit of length.

William Sellers & Co., who introduced the system in the manufacture of injectors, write:

> Our experience with the metric system, extending over 50 years, does not encourage us to extend its use beyond the borders of the shop and the class of work for which it was originally started.

Weighing and measuring instruments including pressure gages, etc.: Slightly (8), Considerably (2). The H. W. Johns-Manville Company, who report Slightly, say:

> When we have orders for speedometers for Latin countries or Germany, we make them to show kilometers and not miles. On orders from Russia, we make them to show Russian versts and not miles. The number of instruments sold to these countries is very, very small as compared with countries using miles.

The L. S. Starrett Company (in export trade 25 years), who report Considerably, say:

> We estimate that not more than 5 per cent of our product is in the metric system.

The Richardson Scale Company (in export trade 12 years) who report Slightly, say:

> Our scales being of the even arm type, our weights are all dead weights and it makes no difference what kind of weights are used. [Which is to say that the scales supplied to metric countries are *identical* with those supplied for home trade.]

American makers of weighing and measuring instruments have developed a large export trade and, for metric countries, they are, of course, to give their indications in metric units. For example, weighing scales of the dial type are made to read in kilograms, linear measuring instruments in millimeters and pressure gages in kilograms per square centimeter.

Worm gears and lead screws: Slightly (1).

EXCLUSIVE USE OF THE METRIC SYSTEM IN PRODUCTION

One representative of each of the following industries replies to the first question by placing his cross in the Exclusively line.

Carbon products (1), proprietary medicines (1), coin-operated machines and violin virtuoso instruments (1), piston-head packing rings for automobiles (1), drills, reamers and tools (1), adamite rolls and miscellaneous castings (1).

THE SECOND QUESTION

> We have found it advisable to pack our goods for trade with metric countries in containers of metric dimensions or containing metric weights to the following extent:

The use of the metric system disclosed by the second question, while of trifling importance as compared with the use covered by the first question, is even more instructive as a means of showing the slight call for its adoption for the benefit of export trade.

If we pass over the use of the system in shipments due to the fact that several foreign governments compel its use for customs purposes, the conclusion is forced upon us that, were this government support withdrawn and the system left to stand or fall by its merits, this commercial use of it would practically disappear from our export trade. Three producers of food products report slight use of metric containers (two of them for lard only), one reports considerable use of such containers, and one extensive, if we include corn products which are partly food products.

The second question was intended to cover those goods which are shipped in tin cans, pasteboard boxes and other containers of definite metric weight or capacity.

Replies immediately began to come in with crosses opposite Slightly, Considerably, Extensively and even Exclusively, but with remarks added in footnotes or accompanying letters that the practice consisted only in marking weights in kilograms on shipping cases, and bills of lading to meet the requirements of foreign customs departments and consular invoices or of customers who called attention to the requirements.

This use of the metric system is on an entirely different basis from the use of metric containers. Metric containers are used because of a commercial need, but this use of the system represents a case in which the laws of other countries reach into our own.

Putting a machine in a box, weighing the box in pounds and then stenciling the equivalent weight on the box in kilograms does not make it a metric container. To clear up this point the following rubber-stamp impression was added to outgoing questionnaires, alongside the second question:

> If this use of the metric system consists of nothing more than giving weights of shipments in kilograms to meet Customs and Consular Invoice regulations, that fact should be noted under Remarks and Particulars.

Following is a summary of the replies to the second question:

TABLE 2 SUMMARY OF REPLIES TO THE SECOND QUESTION

	Count of returns	Per cent
Not at all	746	51.6
Slightly	24	1.7
Considerably	16	1.1
Extensively	13	0.9
Exclusively	1	Negligible
Give metric weights and, in a few cases, dimensions on shipping cases and bills of lading	546	37.9
No reply to this question	99	6.8
Total	1445	100.00

Certain classes of goods cannot possibly be shipped in tin cans, pasteboard boxes or other metric containers. Those which obviously belong in this class are as follows:

Slightly: Automobile trucks (1), Elevating machines (1), Pumps (1), Automobile accessories (1), Oil-mill machinery (1), Rock-crushing machinery (1), Oil-well supplies (1), Gas engines (1), Wrenches (1), Belting (1), Oiled clothing (1), Counting Machines (1), Cotton goods (1), Shirts and collars (1), Steel castings, wheels and springs (1). Total (15).

Considerably: Grain-cleaning machines (1), Electrical machinery (1), Chains (1), Mining machinery (1), Ice-making machinery (1), Automobile tires (1), Machine tools (1), Fertilizer machines (1), Bolts, nuts, and rivets (1). Total (9).

Extensively: Cast-iron pipe (1), Automobile tires (1), Paper (1), Cotton duck (1), Athletic goods (1), Gas meters (1). Total (6).

Exclusively: Machinery pertaining to the meat industry (1).

There remain the following industries which are here credited with the use of metric containers.

Slightly: Food products (3) (in two cases, lard only), Photographic apparatus, materials and supplies (1), Tape measures (1), Petroleum products (1), Tobacco products (1), Rubber goods (1), Zinc products (1). Total (9).

Considerably: Food products (1), Scientific apparatus (1), Flour and feed (1), Candles, stearine and glycerine (1), Varnishes, etc. (1), Lubricants (1), Lithopone (1). Total (7).

Extensively: Corn products (1), Belt preservatives (1), Chemicals (2), Candles, stearine and oil (1), Radium, vanadium and uranium (1), Products not named (1). Total (7).

Exclusively: None.

Put in tabular form, we have the following figures for those who may be credited with the use of metric containers, although some of them are very, very doubtful:

	Count of returns	Per cent
Slightly	9	0.6
Considerably	7	0.49
Extensively	7	0.49
Exclusively	0	0.0
Total	23	1.58

Repeatedly, in these papers such expressions as "to South America only," or "to certain South American countries" appear, with several special references to Chile as the most insistent of all countries in this matter. A few follow the practice when shipping to some European countries, but the requirement that bills of lading and weights of parcels shall be given in metric terms appears to be confined to South American, and, perhaps, Central American countries.

Replies to the number of 106 place the cross for the second question in the Not at All line, and follow this under Remarks and Particulars with the statement that they make out shipping documents and give weights of shipping parcels in metric units. Such replies are clearly a discrimination between metric containers and the giving of weights of shipments in metric terms, and, in the intended meaning of the second question, should be included in the Not at All replies. This, however, has not been done, all such replies being included in the classification of those who give metric weights on shipping cases and bills of lading.

The questionnaire was not framed to bring out the effect of the laws of foreign countries on shipping methods, and, had it been so framed, no definite summary of the facts could have been obtained because the extent of this use of metric units in the case of any shipper depends upon the countries to which he makes shipments. However, many remarks upon the papers throw light upon this phase of the subject. Of these, the following are typical examples:

In a small part of our shipments, we find it necessary to give weights in kilograms. (In export trade 10 years.)

In some instances we have had to make crates with metric dimensions and weights, and have given metric dimensions on invoices. (15 years.)

We sometimes mark tags and boxes with the metric system.

Possibly 2 per cent of the export shipments. (10 to 15 years.)

This is not required on more than 10 per cent of our export shipments. (25 years.)

In some instances we have been requested to put the weights in the metric system as well as our own. (135 years.)

Occasionally, besides the English net and gross weights, we are requested also to give the kilos. (9 years.)

Sometimes asked to give all particulars of weights and measurements in metric figures. (60 years.)

For customs purposes in a very few instances. (12 years.)

Occasionally we have a request to give size of crate and weight of shipment in advance in the metric system. (15 years.)

Applies to about 1 per cent of our shipments. (20 years.)

Occasionally requested to give not only the weights in kilos, but also the metric measurements of the packages. (10 years.)

This applies to dimensions of packing cases which all countries accept from us in cubic feet and cubic inches. (10 years.)

The request for use of the metric system is not general or universal from all our customers in any one country. Some customers require it, while others in the same country do not. (30 years.)

Ship both English and metric containers to the same countries. (Almost a century.)

Have several times shown metric dimensions, weights, etc., on invoices and cases. (20 years.)

Occasionally give weights of shipments in kilograms. (30 years.)

Many more similar quotations could be given, but the above are sufficient.

The Third Question

In our literature for, and correspondence with, metric countries, we have found it advisable to give information regarding weights, output, capacities, over all dimensions, etc., in metric terms as follows:

Following is a summary of the replies to the third question:

TABLE 3 SUMMARY OF REPLIES TO THE THIRD QUESTION

	Count of returns	Per cent
Not at all	835	57.8
Slightly	279	19.3
Considerably	114	7.9
Extensively	78	5.4
Exclusively	38	2.6
No answer to this question	101	7.0
Total	1445	100.00

The use of the system covered by the third question involves the case of machinery, no more than the giving of capacities, weights and overall dimensions in metric equivalents; in the case of structural materials, the giving of weights in kilograms per meter instead of pounds per yard with leading dimensions of sections in approximate metric equivalents; and in other cases the giving of prices per kilogram or per liter instead of per pound or per gallon.

Why do but 42 per cent of our exporting manufacturers find occasion to make any use of the system and but 8 per cent of them to make extensive or exclusive use of it in this simple way? Because buyers in other countries understand our units precisely as we understand theirs—but better.

Conclusion

The conclusion is that the export trade of the United States is conducted by the English system. From Table 1 we learn that 82 per cent of our exporters to metric countries use the metric system not at all in production, while 14 per cent use it partially and in ways that, when explained, are inconsequential; and 0.4 per cent really use it exclusively.

In the commercial use of the system the results are equally striking. By the supplementary table under the second question we find that 1.6 per cent of our exporters thus use the system in response to a commercial need, *not one* exclusively, and, while 38 per cent make some use of it in shipments because compelled to do so by the laws of foreign countries, these uses, in the light of the extracts from letters in reply to the second question, are unimportant and show that the influence of such laws when confronted with the customs of commerce is slight.

APPENDIX

Since this Report was prepared, information has been received from England regarding the outcome of the metric agitation in Great Britain. In 1916 the British Government appointed a Committee on Commercial and Industrial Policy After the War, a copy of whose official Report to Parliament has been received. This Report deals with many phases of Great Britain's future industrial policy, Chapter X being devoted to Weights and Measures. From this Chapter, the following brief extracts are made:

Having given very full consideration to the subject, we are unable to recommend the compulsory adoption of the metric system in this country.

In our opinion, it is absolutely certain that the anticipated uniformity could not be obtained for a very long period, if ever.

There is, further, the serious objection that if we induced the above-mentioned countries to change over to the metric system, we should be surrendering to Germany the advantage which our manufacturers now enjoy over here, both in their markets and our own.

We are informed that even in France, which has made the metric system nominally compulsory for more than half a century, the "pouce" (or inch) is used in textile manufacture and numerous local measures still survive.

In referring to these considerations, we have to point out that there is no unanimity even as to the theoretical merits of the metric system as compared with our own. The practical argument that its adoption is desirable in order to secure uniformity in the markets of the world has been shown to be unfounded. We are not satisfied by any evidence which has been brought before us that trade has actually been lost to this country owing to the fact that the use of the metric system is not compulsory.

But to attempt to make the use of the system universal and obligatory in this country would cause great loss and confusion at a particularly inopportune moment for the sake of distant and doubtful advantages. We are convinced that, so far from assisting in the reëstablishment of British trade after the war, such a measure would seriously hamper it.

As regards the educational advantages claimed for the change, we have been referred to a statement quoted by the Select Committee of 1895 that no less than one year's school time would be saved if the metric system were taught in the place of that now in use. The information which we have received does not support that statement, and even if it were well founded, it must be remembered that for at least a generation, children would have to learn both the new and the old measures and how to convert from one to the other.

It is often popularly supposed that the introduction of the metric system would render possible the immediate sweeping away of many complicated and varying weights and measures. As we have already indicated, this belief is, in our opinion, wholly fallacious.

We are not convinced that the metric system is, upon the whole, even theoretically superior to the British system, and we are satisfied that the practical objections to the proposed change are such as decisively to outweigh any advantages which are claimed for it.

It is to be noted, moreover, that while in an Appendix to the Report several members of the Committee, which consists of nineteen members, file reservations regarding certain items, there is no reservation regarding the Chapter on Weights and Measures. In other words, the Report, so far as this Chapter is concerned, is unanimous.

The American Institute of Weights and Measures has several members in Great Britain through whom this Report has been transmitted. Letters from these members point out that in England this Report is looked upon as concluding the discussion and ending the controversy.

LABOR TURNOVER MEETING OF NEW YORK SECTION

A WELL-ATTENDED meeting of the New York Section of The American Society of Mechanical Engineers was held at the Engineering Societies Building, New York City, on Tuesday evening, May 21, 1918, to discuss the timely subject of Labor Turnover, George R. Woods acting as chairman.

The first speaker, JAMES J. PEARSON,[1] explained the British system of zoning the country for munition orders. All factories, he said, were either registered or not; i. e., if they had voluntarily offered their services to the Government and had been accepted they became registered and were kept busy on Government work. The country was divided into areas and the Government was represented in each area by an engineer, secretary and staff, and by an employment office. All workmen were listed and were either W. M. V. (Workmen Munition Volunteers) or not; in the first case they could be sent to any part of the country where their particular services were most required. Further, each workman was classified as A, B or C, according to his fitness. The labor unions had sidestepped their internal grievances and coöperated with the Government in meeting the needs of the times. The speaker was of the belief that the present labor troubles in England were essentially local in character and quoted several instances attesting the patriotism and determination of the people in general who applied their whole energy to increase the output of munitions. During an air raid over Bolton, which resulted in the death of about 130 workmen, the women workers stuck to their jobs in the factories while their men folk were facing murder and sudden death outside.

ORRIN W. SANDERSON[2] complained of the excess to which discussion on labor turnover was carried without seemingly coming to a definite estimation of its causes. His company employed over 20,000 men and operated 60 different departments, one of them being the Industrial Relations Department. The records of the employment office which were kept very elaborately and included the reasons prompting the men to leave, appeared to indicate that while there was no absolute remedy for labor turnover, it could be nevertheless considerably lessened by giving more consideration to the workmen and by curtailment in the advertising for help.

DUDLEY KENNEDY[1] illustrated some of the difficulties his corporation had encountered from the labor standpoint. With a contract to build 120 ships in 18 months starting from November 1, they had succeeded in keeping an average of 25,000 men a day on duty by employing 130,000 men in six months. This excessive turnover of 420 per cent was to be explained in part by the lack of commodities and conveniences of the new place where the corporation had rapidly established itself. He emphasized the fact that there was more labor turned over in the United States than was necessary to man all of the industries of the country and that this must be checked. The practical step recently taken by the Government in appointing a labor dictator to regulate wages would help toward keeping them at a reasonable level so that there would not be an incentive for a man to change from one job to another.

H. F. J. PORTER[2] dwelt on the necessity for organization by a group of men before it could have dealings with any one. Therefore, he concluded, if two groups were properly organized, one on the part of the employer to devote its energies in looking after the conditions of labor, and the other on the part of the employee to bring workmen into a condition of efficiency, it would be possible for these two to coöperate in improving labor turnover by considering the suggestions or grievances of the laborers and discussing them through representatives with the management.

[1] Late of the British Ministry of Munitions.

[2] Director of Labor, B. F. Goodrich Co., Akron, Ohio. Assoc.-Mem. Am.Soc.M.E.

[1] With American International Shipbuilding Corporation, in charge of shipbuilding plant at Hog Island.

[2] Consulting Industrial Engineer, 200 Fifth Ave., New York, N. Y. Mem.Am.Soc.M.E.

JOHN CALDER[1] summarized the reasons why employees left after short periods and the motives which prompted the employers to release or dismiss them. Incompetency, unwillingness, etc., were plausible causes for dismissing a workman, and yet in some cases they might arise from conditions which it would be easy to remedy, such as failure on the part of the employer to teach beginners. Outside of these reasons, however, there were two others more important in causing labor turnover, namely, draft selection and competition of manufacturers. The present military necessities had developed an undesirable state regarding the classification of the drafted men and some of these had been called from industrial occupations where they were rendering their best possible service to the country. Such a condition had existed in England and France at the beginning of the war and had created there a present shortage of skilled laborers, many of whom had been disabled in the fields of battle. His own experience in building up a force of 1000 employees at short notice had led him to believe that a great deal of good could be accomplished and much future trouble avoided by maintaining friendly relations with the local and district draft boards, who had no time to visualize the situation and would be greatly assisted by any information regarding the needs of the industries in their district.

CAPT. BOYD FISHER[2] told the audience of a six weeks' course for employment managers given at Rochester University and of his efforts to have this preliminary course given at other institutions. The plan was to select from among the men with from three to five years' industrial experience and a fairly complete high-school or college education those who had the temperament and personality required of an employment manager and give them this brief training. The Ordnance Department, the Quartermaster's Department, the Navy Department, the United States Fleet Corporation, the Department of Labor, and the Educational Committee of the General staff, had all combined on this program.

L. D. BURLINGAME[3] presented a record of the results obtained by his company during the sixteen months that they had hired women in their shops. The record showed that during each month of this period the hirings were greater than the number leaving, the opposite being the case with the men. The comparison of turnover between the two sexes was made by obtaining for each the number hired per *job made vacant*. Thus, for employees averaging 1½ months in service, the same job would have to be supplied eight times, and if there were 800 who had left with that average service, they would represent but 100 jobs made vacant. In this manner it was found that during the year 1917 but 1.5 women were employed for each job vacant, the record for the whole shop, including men, being 2.2 hired per job vacant. During the first four months of the present year these figures were 1.8 and 2.6, respectively. While on the basis of those leaving a larger percentage of women than of men had so far been discharged this year, on the basis of those entering the figures were reversed, that is, fewer of the women hired had been discharged in proportion, this being in the ratio of 15.6 per cent men to 11.8 per cent women. During 1917, 23 per cent of the men were discharged and only 11 per cent of the women. Among those leaving voluntarily the percentage of women leaving was greater than among men. It should be remarked, however, that night work, in which men only were engaged, was distasteful and many men left because they objected to such work. These investigations indicated that an important asset in reducing turnover consisted in providing for the convenience of employees in securing homes with comfortable surroundings. Another important consideration was the relation of foremen and fellow-workmen, as this had very much to do with a man's contentment and efficiency in his place of employment. As to the class of girls who could be successful in work of the character here referred to, it was found that those who had had previous experience in employment were far more likely to become permanent and satisfied employees than those who came directly from homes and had had no background of training.

H. E. MILES[1] classified labor turnover as a symptom of defective management. Just as a shop required a tool room, so it required a training room to produce the machinists who would manufacture the goods. In every factory in England that did war work they compelled them to adopt this training-room method, and in France the Ministry of Munitions had studied all of the ways that had been tried out in their three years of war, and more than a year ago they had required every factory in France employing 300 people or more to put in a training room to train the operators. Mr. Miles showed some slides of the work women were doing in the English factories. In tool rooms girls worked to 0.008 in. after sixty days' training. There was not a single piece in aeroplane work that was not being constructed by women, from the roughing of the crankshaft to the last bit of canvas or muslin put on the machine. Women were grinding to 0.0004 in. and were taught to do this in sixty days. He concluded that in view of the records of the English and French factories where labor turnover had been so greatly reduced by the establishment of a training room, it appeared that the employers of this country had a second obligation which they had been slow in recognizing.

MAJOR E. N. SANCTUARY[2] said that an officer had been appointed by the Secretary of War to coördinate all of the various branches of the department with the idea of reporting back to headquarters with any corrections or suggestions that would tend to eliminate the lack of coöperation which had existed in the past. This officer had suggested the proper utilization in the army of the large number of men who, on the final physical examination, had been found unable to go abroad with their divisions. Thus the conservation of man power would be effected through this new agency of the War Department working in connection with the War Service Exchange, the Committee on Education and Special Training, which was turning out 10,000 technical men every month, and other organizations that would help in delivering the right kind of men to the Government.

J. J. SWAN[3] summarized the work done by the Committee on Classification of Personnel in the Army, which has, among other duties, the allocation of all skilled tradesmen throughout the Army. Following the example of England, where 70,000 shipbuilders, 15,000 machinists, and 40,000 coal miners had to be called from the fighting line after several months of training, some 7,000,000 cards, each one indicating a drafted man's trade and his first, second and third preferences as to the character of employment he would desire, were kept on file

[1] Aero Marine Plane and Motor Company, Keyport, N. J. Mem.Am.Soc.M.E.

[2] Ordnance Department, U.S.A.

[3] Industrial Superintendent, Brown & Sharpe Mfg. Co., Providence, R. I. Mem.Am.Soc.M.E.

[1] Member Council of National Defense.

[2] War Service Exchange of the Adjutant General's Office, Washington, D. C.

[3] Member Committee on Classification of Personnel in the Army, Washington, D. C. Mem.Am.Soc.M.E.

with the Provost Marshal. When a call came for specialists the information was passed through to the local Boards and the tradesmen furnished. All the trades were analyzed and standardized, as well as the language throughout the entire Army, and the results printed in book form, alphabetically arranged, with an index covering the trade and a cable index for foreign communication. Similarly the Labor Department had undertaken the standardization of the munitions and shipbuilding trades. There would be specifications of the jobs and it was hoped that there would be ultimately a telegraphic clearance of labor conditions throughout the country as was the case with the Weather Bureau at this time, thus doing away with destructive competition. The question of wages would be taken care of automatically, the local price being determined by reference to local living conditions and other considerations. It was realized that it was impossible to draw the number of tradesmen required, and so the Government had instituted a series of trades schools, of which there would soon be one hundred equipped to give 100,000 men an eight weeks' training course.

J. B. DENSMORE[1] stated his belief that the fundamental difficulty the Government had had in handling the labor problem on a large scale, was lack of standardization of wages in both skilled and unskilled labor, lack of housing and local transportation, and the permission granted to all war industries to recruit their own labor. He assured the meeting on the part and with the authority of the Government that all of the competitive bidding and all of the independent labor recruiting by the war industries in this country was going to be stopped by the Government. There were a few preliminaries which must be taken care of before the whole machinery to handle the entire economic problem of labor in production could be arranged and announced. He felt that the only remedy for the present conditions was the standardization of wages and the establishment of a single labor-supply agency. It was shown by the records of the U. S. Employment Service that in places where it had had the exclusive labor supply, both skilled and unskilled, the labor turnover had been considerably reduced.

G. K. PARSONS[2] prior to adjournment of the meeting, proposed a motion to the effect that the chairman appoint a committee to take immediate action to determine how the Society could render the greatest assistance in the solution of the problem of labor turnover. This motion was carried.

Suggestions to Aeronautical Inventors

It is announced by the Air Ministry of Great Britain that the Air Inventions Committee, formed about nine months ago, has now received and examined upward of 5000 inventions and suggestions relating to the air service and a statement has been issued to facilitate the work both of inventors and of the Committee. These suggestions are of equal interest to those in this country.

Owing to the conditions of the war, it is practically useless to submit inventions which would necessarily take a long period to develop; and, generally speaking, no very startling change in the present type of aircraft is anticipated, although improvements in parts and details are always possible, and may produce very important results.

The stage of development in construction which has now been reached is such that major improvements can only be expected from those possessing the requisite scientific and mechanical knowledge, skill and experience. Thus, radical changes in the shape of the wings of aeroplanes, the body, and the propellers are only possible after long and patient research carried out in aeronautical laboratories. Again, many inventors have forwarded proposals for helicopters and aircraft of a similar nature, which, if an efficient design could be produced, would possess certain advantages—but probably not to the extent at one time imagined. Others have suggested flapping wings and rotatory planes. Such schemes do not give any promise of being capable of development for use during this war.

As regards minor improvements, inventors should bear in mind that many details, such as turnbuckles, clips, etc., are now standardized, and that a change would only be justified by some very marked superiority. Safety devices for the machine and the pilot form a numerous class among the ideas submitted. The chief means suggested is the parachute, either applied by a harness to the pilot or directly attached to the machine. Those who have seen a passenger dropped by parachute from an aeroplane for exhibition purposes often fail to realize the conditions under which a parachute may have to be used as a safety appliance. The machine may be out of control, dropping at a velocity of 150 to 200 miles per hour, or spinning downward in flames. Many other safety devices such as automobile stabilizers, wind brakes, etc., have been proposed at various times. The additional weight incurred by the use of many of the suggested safety appliances must remain a very serious factor so long as war conditions prevail.

The engine is the heart of the aeroplane, and on its reliability depends the safety of the pilot. People acquainted only with motor-car engine practice sometimes do not realize the exacting conditions under which an aeroplane engine must work. The engine has to be capable of running for the whole of the time of flight at its maximum power. The lubrication and ignition must be perfect, and the engine must not become overheated. The rating applied to an aeroplane engine is its weight per horsepower. Engines which differ radically from present-day practice—such as the internal-combustion turbine—have small possibilities of being adopted, for successive design and reconstruction entailing probably several years' work are necessary before satisfactory results can be expected.

A subject intimately connected with the power plant is its noise. This noise constitutes one of the disadvantages of an aeroplane. For night flying a method by which it would be possible to hear from one aeroplane the approach of another would be of great advantage. The engine can be silenced without serious disadvantages, but the noise of the propeller and the hum of the wires are so great that silencing the engine is not sufficient to achieve the object in view.

Many hundreds of inventions and suggestions for inclinometers and instruments for straight flying and accurate bomb dropping have been investigated. Efficient and well-designed instruments for these purposes have been available for some time past, but it is quite possible that improved forms may still be produced, though it is scarcely likely that this can be done by any one who does not possess the scientific and mechanical knowledge required for an investigation of the nature involved. Some inventors of aeronautical instruments entirely disregard the action of centrifugal force upon pendulum and spirit-level devices. Many gyroscopic instruments have been proposed which show the inventors to possess insufficient knowledge of the correct application and limitations of a gyroscope. (*The Engineer*, vol. 126, no. 3262, July 5, 1918, p. 5)

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[2] President, The G. K. Parsons Corporation, New York, N. Y. Mem. Am.Soc.M.E.

ENGINEERING SURVEY

A Review of Progress and Attainment in Mechanical Engineering and Related Fields, Including Abstracts of Articles in Current Technical Periodicals

Tractor Tests at Salina, Kan.

At the National Tractor Farming Demonstration, held at Salina, Kan., July 25 to August 2, fifty tractors of nearly as many different makes were represented, and on the afternoon of the second day all started plowing a 240-acre field of winter-wheat land, some of the furrows being half a mile in length.

Belt, fuel-economy and drawbar-pull tests were conducted on many of the tractors exhibited by a committee of agricultural engineers selected from different state agricultural schools under the direction of J. B. Davidson, Mem.Am.Soc.M.E., professor of agricultural engineering at the University of California, but owing to objections of a number of tractor makers the results of these tests will not be made public until later.

Prior to the trials proper, however, the Parrett Tractor Company, of Chicago, Ill., started a 100-hour non-engine-stop plowing demonstration, the results of which have been given out. According to correspondence in the issue of *Automotive Industries* for August 8, the engine was run on kerosene for 103 hr. 19 min., during which period there were two stops totaling 5 min. 40 sec. due to sediment in the fuel line between the kerosene tank and the carburetor. It was necessary, however, to stop plowing for 13 hr. 28 min. on account of rain.

The tractor plowed for a total period of 80 hr. 42 min. 20 sec. and averaged 2.4 miles per hour while pulling its three 14-in. Oliver plows and plowing furrows averaging 6.36 in. in depth. Traveling at this speed it averaged 0.95 acre per hour. Kerosene was used exclusively as a fuel and the consumption was 1.99 gal. per hour, equivalent to 2.008 gal. per hour-acre, the unit of measurement adopted.

The consumption of lubricating oil was 1 gal. per 12 acres plowed, or 0.084 gal. per hour-acre. A water air cleaner was used and 7.5 gal. of water were required. Much of this water was found to enter the cylinders and serve in keeping down the temperature of the kerosene mixture. During the test 24.2 gal. of water were used in the radiator, or 0.314 gal. per hour-acre.

It was demonstrated during the test that plowing can be done at night as efficiently as in the daytime. The tractor was equipped with two Prest-O-Lite lamps which provided ample illumination for this purpose.

Report on Airplane Problems

The desire to enlist the inventive talent of America in the solution of aeroplane improvements has led to the issuance of a new bulletin by the Naval Consulting Board and the Engineering Council's War Committee of Technical Societies. The bulletin opens with a summary of the possibilities for improvement in aeroplane motive power, following which is a paper contributed by E. H. Sherbondy, of the U. S. Airplane Engineering Department, Bureau of Aircraft Production, War Department, in which are further discussed the various elements in which improvement may be expected.

For manufacturing reasons the Government finds it necessary to standardize motor design and is not now in a position to consider improved motors and systems of power. Such questions must be deferred until after the pressing needs of the hour have been met. The main problems are in the connection of the engine with the airplane and in the accessories which are necessary for the proper control of engine and plane. This includes the arrangements of pipe, wire, radiators, water connections, etc. New arrangements of tanks to make the plane more bullet-proof and to decrease the danger from fire should be studied.

The following figures for the efficiency of the aeroplane motor and propeller are of interest:

Energy of fuel delivered by engine shaft to propeller (Thermal efficiency). For the indicated hp. 30%. For the brake hp.	25%	
Energy consumed by engine friction	5	
Energy lost by cooling	30	
Energy escaping in exhaust (including that of unburned fuel)	40	
Total fuel contents	100	
Mechanical efficiency of propeller		75%
Net energy of fuel delivered by propeller and available for flight (0.75×0.25)		19%

The question of carburetion under the extremes of barometric and temperature conditions met with in flying are fully discussed. The richness of the carbureter mixture increases with the altitude and varies inversely as the square root of the ratio of barometric pressures. Temperature effects are relatively much smaller. Carbureter regulation for varying altitude, therefore, is of the utmost importance, and for this purpose at least two devices have already been produced, which are mentioned in the bulletin. Thermostatic apparatus for temperature control is less important and its value largely depends upon its freedom from complication.

In spite of the fact that the best talent of the country has been at work upon ignition problems, this is still a promising field for investigation. The difficulties met with in automobile practice are multiplied in the airplane, due in part to the higher compression. Good electrical conductors are poor heat conductors, and the high temperatures of the aeroplane motor cause a breaking down of the electrical insulating qualities of the spark plugs. At low engine power also there is the trouble from carbonization, which can be corrected by a better system of lubrication.

W. F. Durand, Mem.Am.Soc.M.E., Scientific Attaché, American Embassy, France, contributes a valuable chapter on Problems in Aeronautics, in which he discusses materials for airplane construction, ties and fastenings, supercharging engine, airplane instruments, etc. He draws attention to the possibility of a greater use of sheet metals, the chief advantage of which for wing surface or covering would be non-inflammability and perhaps greater durability, but no wing covering can be considered which is markedly heavier than present forms for the same strength. Present coverings weigh from 4 to 4.5 oz. per square yard and have a tensile strength per inch of width of 70 to 80 lb. Any proposed substitute form must also give a smooth and continuous surface comparable with present forms. For the wing skeleton or frame, steel or aluminum alloys are attracting attention and seem to offer possibilities.

For fuselage construction steel or metal construction seems here also to offer hopeful possibilities, but under general limitations of equivalence regarding weight and strength com-

pared with wood. For ties the use of steel wire cable is standard and practically universal. This product is of very high grade, but there is room for improvement even here, both in the material employed, in the mode of laying up wires to form a complex tie member and in the form of section of such member. Joint fastenings are commonly made of sheet steel or sheet bronze. There is room for improvement expressed in terms of ease of manufacture, economical distribution of material, facility for attachment of wire or cable ties, and general adaptation to purpose.

The report closes with an extended bibliography.

Inventions and ideas should be submitted to Thomas Robins, secretary Naval Consulting Board, 15 Park Row, New York.

Machine Tools for Relining Guns

A recent development in the heavy-machine-tool situation is the announcement in the *Official Bulletin* of August 12 of the equipment which will be required for the Arsenal in France where the heavy guns of the American forces are to be relined. The relining of big guns is one of the biggest salvage operations in the war, as several times the value of the guns is saved by this process. The project for this relining plant is one of the largest undertaken by the Ordnance Department, and calls for the expenditure of between $25,000,000 and $30,000,000. The machine tools will cost between $12,000,000 and $15,000,000, and will consist of gun-boring lathes, engine lathes, rifling machines and grinders.

Among the equipment are to be nearly fifty 102-in. gun-boring lathes, which it is understood are to have reinforced-concrete frames, and a very large number of 84-in. lathes. In the building of the 102-in. lathes, a giant planer with a bed 500 ft. long, now under construction, will be used. It is stated that the bed is of such length that in its alignment a correction will have to be made to allow for the curvature of the earth's surface.

In addition to the machine-tool equipment required, the relining plant in France will include extensive shrinkage pits, traveling cranes of 240 tons capacity and an electrical generating plant of several thousand kilowatts capacity.

During the past few months, while the Ordnance Department has been outlining its requirements for heavy machine tools, the Society has assisted in every possible way. The subject was discussed at the Spring Meeting at Worcester, and President Main appointed the Society's Committee on Machine Shop Practice as a Committee on Heavy Machine Tools. Through its efforts, Mr. G. E. Merryweather, Mem.Am.Soc. M.E., was appointed by Mr. Baruch as "Machine Tool Dictator," and members of our Committee have been in consultation with him and with Government officers at intervals.

Grenades

The War Department authorizes the following:

More than 18,000 persons are employed in plants throughout the country in the manufacture of hand and rifle grenades. Hand grenades are now being produced at the rate of 2,000,000 a month, and within the next four months this rate will be doubled. Rifle grenades are being produced at the rate of about 1,000,000 a month, and this rate will be multiplied appreciably within the next six months.

The hand grenade may be of the defensive, the offensive or of the chemical type, of which latter there are two classes, phosphorus and gas.

The defensive grenade is the most powerful and the one generally used when tactical conditions permit, being thrown from cover at an advancing foe. It is about the same size and shape as a very large lemon with a body or shell of gray cast iron scored with deep grooves longitudinally and transversely to insure proper fragmentation when it explodes.

The offensive grenade differs from the defensive in that it depends entirely upon its explosive effect for its usefulness against the enemy and is generally used at shorter range, in offensive tactics, and when the grenadier is not necessarily under cover.

The phosphorus grenade has a barrel-shaped container of drawn sheet steel, about 3½ in. long and 2¼ in. in diameter; to one end of this body is welded a steel collar or bushing, threaded on the inside. Into this collar is screwed a steel thimble which runs down into the center of the inside of the body of the grenade; this thimble is designed to prevent the phosphorus charge from coming into contact with the detonator and fuse. These last, together with the standard *bouchon* assembly of which they form a part, are screwed into the top of the thimble, which is threaded on the inside for this purpose. The grenade is painted gray when loaded (live).

The phosphorus grenade furnishes a shower of burning fragments of phosphorus as well as a cloud of dense white smoke, which can be used to repel an advancing attack, or if thrown during an advance, would both furnish a screen to conceal the advance and repel any enemy parties that might be in the open.

The gas grenade is in construction similar to the phosphorus grenade. It produces a low-lying cloud of dense white gas of an intensely irritating nature which may be classed as suffocating gas. It is used largely in what might be termed "mopping-up" the trench, cleaning out dug-outs by forcing the enemy into the open, or forcing him to wear a gas mask during the advance.

Rifle grenades are used to fill in the gap between the hand grenade and the light trench mortar. The type used by our army was designed by two Frenchmen, Vivens and Bessieres, and in their honor is called the V. B. rifle grenade. It is about 2½ in. long, 2 in. in diameter and is fired from the discharger which fits over and is attached to the muzzle of the rifle in the same manner as a bayonet.

The regular rifle cartridge is used and the grenade is thrown from the discharger by the gases from the cartridge. The bullet fires the primer in passing through the central tube of the discharger. The flash is transmitted to the fuse, timed to burn eight seconds; and the fuse in turn fires the detonator, which bursts the walls of the detonator tube, and fires the main charge, thus exploding the body of the grenade. The normal range, when the rifle is aimed at 45 deg., is about 200 yd. (*Office of the Chief of Ordnance, General Administration Bureau, Information Section,* August 3, 1918)

Training of Women Begins

Toward the middle of July a two-months' course to train women for war work as employment managers was opened in the Case School of Applied Science, Cleveland, Ohio. The course is under the direction of the United States Ordnance Department through the Committee on Labor Relations of the Cleveland Chamber of Commerce, and Miss Mildred Chadsey, of Western Reserve University, is directing the work.

Applications for enrollment were received from 200 women from all sections of the country, from whom 50 were selected. Many of these are college graduates, some have been teachers, and their ages range from 25 years up.

The course consists of daytime factory work and evening classes. It differs materially from the one given for men under Government direction in Eastern schools because few of the women have any practical experience around a manufacturing plant.

The Cleveland manufacturers are heartily coöperating in the work and have willingly taken the students in their shops. The plants in which they are employed as regular operatives include the American Multigraph Co., Cleveland Hardware Co., Cleveland Metal Products Co., Hydraulic Pressed Steel Co., Osborn Mfg. Co., Standard Parts Co., Standard Tool Co., Warner & Swasey Co., Kirk-Latty Mfg. Co., and the Steel Products Co. (*The Iron Age*, vol. 102, no. 4, July 25, 1918, p. 199)

Photomicrographs of Changes in a Metal's Structure When Under Repeated Stresses

A striking feature of the annual meeting of the American Society for Testing Materials at Atlantic City in June, was the presentation by Prof. H. F. Moore, of the University of Illinois, Urbana, Ill., of a film of photomicrographs taken at various periods in the disintegration under repeated stresses of a wrought-iron test piece. It evoked so much interest that on request it was repeated the next day.

Though applied in this instance to wrought iron because of its large crystals, distinct markings and easy deformation under stress, it is not improbable that that principle will be later applied to steel, non-ferrous metals and other alloys. This may solve many problems now not fully understood and may lead to a scheme of heat treatment prolonging the life of certain steels and rendering them less liable to fatigue.

A. G. Eldredge, head of the Department of Photography, University of Illinois, perfected the optical and photographic arrangement whereby the taking of these photomicrographs was made possible. (*The Iron Age*, vol. 102, no. 6, August 8, 1918, pp. 323 and 325)

The Peat Industry

According to statistics of the United States Geological Survey, the peat industry has increased 420 per cent during the past ten years. The gross market value of the present output is $709,900; with proper productive methods it is expected that the price per ton can be reduced to $2.50 from $7.29, price in 1917, when there were but 18 producing plants distributed on the Atlantic Coast and in the Middle West.

Peat or muck consists of partly decayed vegetable remains that contain enough carbon to burn freely when dry, and ranges from the imperfectly decayed kind, of a light yellow color, to the thoroughly disintegrated jet-black type. In an undrained swamp it contains about 90 per cent of water, which must be reduced to 30 per cent before it can be used for fuel. No artificial drying process of commercial value has been developed.

This material has frequently been used as a source of charcoal and coke, of various by-products from coke retorts, as well as in making paper, substitutes for wood, etc.

Deposits that can be used for fuel are found throughout Minnesota, Wisconsin, Michigan, New York and the New England States, and in the northern parts of Iowa, Illinois, Indiana, Ohio, Pennsylvania and New Jersey; also on the Atlantic Coast from New Jersey to southern Florida and westward along the Gulf Coast to the Mexican boundary. (*Engineering News-Record*, July 25, 1918, p. 202)

Substitute for Silks Being Tested by War Department

Preliminary tests made at the Aberdeen proving grounds indicate that a chemically-treated cotton cloth can be used as a substitute for silk, and if found practicable the discovery will effect the double result of meeting a serious shortage in silk and bringing about a money saving in the ordnance program estimated at between $25,000,000 and $35,000,000.

At present millions of yards of silk are required in making the bags which contain the large powder charges used in the firing of heavy artillery. These bags are inserted in the gun immediately behind the projectile, and the firing of them gives the propelling force that hurls the projectile at the target. The propelling charge is, of course, entirely distinct from the charge within the projectile that explodes the missile after it reaches the target.

Heretofore silk has been depended upon for these bags for the reason that no other cloth material has been found that would meet the peculiar conditions required. It is essential that not a particle of the bag container shall remain after the gun is fired. Otherwise a smoldering piece of the fabric might cause a premature explosion when a new charge is inserted.

Early in the war Germany is understood to have used a chemically treated cotton as a substitute for silk, but has since been compelled by the diminishing cotton supply to resort to other substitutes. (*Journal of Commerce*, August 12, 1918, p. 9)

Cost of Operating Air Mail

The first report of the comparative cost of the operation and maintenance of the Air Mail Service shows that the airplanes used in this service have broken all records for economy of gas consumption.

The total of all operating expenses of nine airplanes covering flights aggregating 7234 miles, was $3682. The total consumption of gas representing 113 hours and 8 minutes of flying was 1377 gal, which is $32.50 per hour—something over 50 cents per mile. The total cost of gas was $405 in flying 7234 miles.

The best performance in flying was made by a Curtis J-N-4 machine, which flew 26 hours and 40 minutes at a cost of $28.01 an hour and covered 1719 miles at a cost of 43½ cents per mile. A plane equipped with a Hispano-Suiza 150-hp. engine used approximately 8 gallons of gas per hour, and a plane equipped with a 400-hp. Liberty motor used 17 gallons per hour. This shows 40 per cent less gas consumed than generally required for airplane engines of these sizes.

The calculation of operating cost includes departmental overhead charges, interest on investment, replacement of parts, deadhead time of mechanics, gas, lubricating oils, office force, motor cycles and trucks; rent, fuel, light and telephone; pay of pilots, hangar men and mechanics.

The average consumption of gas for the nine planes was 12 gallons per hour. (*Official Bulletin*, July 25, 1918, p. 5)

Norway Rushing Work on Concrete Ships

Norway is racing with America for the honor of building the first concrete vessel to cross the Atlantic. Mr. Nick Fougner, president of the Fougner Concrete Shipbuilding Co. (Inc.), Christiania, Norway, states that he hopes to cross the Atlantic within the next two or three months on one of the larger boats which his company is building.

The shortage of wood and steel in Norway has made it necessary for shipbuilders to turn to the concrete vessel in order to offset the losses suffered by the depredations of the U-boats.

The *Stier*, a 1000-ton concrete vessel recently built in the shipyards of the Fougner Concrete Shipbuilding Co., is a pioneer of the type of concrete vessel that is now under construction in Norway. It is equipped with an internal-combustion 320-hp. motor, and has four watertight transverse bulkheads of concrete, which, with a reasonable cargo, makes the ship practically unsinkable.

At present the Fougner Co. has under contract 12 additional seagoing concrete motor ships, varying in size from 200 to 3000 tons deadweight, and they have built and launched about 25 floating craft of various types, including tugs, lighters, motor ships, and dry docks.

It is expected that the Norwegian builders will adopt the new protective coating developed as the result of the research work of the engineers of the Emergency Fleet Corporation. (*Official Bulletin*, July 18, 1918, p. 9)

Over 2,000,000 Rifles Produced by U. S.

Up to and including July 27, 1918, the total number of rifles produced, inspected and accepted by the Ordnance Department was 2,000,768. This number includes 1,523,156 of United States Model 1917 and 280,000 Russian rifles. It does not include the rifles on hand when we entered the war. The number of machine guns of all types produced, inspected and accepted since the beginning of the war up to July 27 was 96,006. The output of pistols during the same time was 414,015.

Machine-gun production continues to show a steady increase, although the output at all plants fluctuates. The number of heavy Browning machine guns inspected and accepted during the week ending July 27 was 1106, a decrease of 257 under production for the previous week. Light Brownings inspected and accepted during the past week reached a total of 2624, an increase of 557 over the previous week. Since the war began and up to and including July 27, the total number of machine guns of all types produced, inspected and accepted included 8428 heavy Brownings and 14,895 light Brownings. (*Official Bulletin*, August 7, 1918, p. 3)

General Notes

At the conference of the Engineering Division, Employment Service, Department of Labor, called by Director A. H. Krom on June 28 and held at the Engineering Club, Chicago, it was resolved to make a survey and registration of all technical persons. This register is to be compiled in conjunction with the War Industries Commission and the classification will be made by employing existing agencies represented by the various engineering and technical societies. Dr. P. L. Prentis, district superintendent, welcomed the assistance of those in attendance, who were: Dean John R. Allen, Dean Mortimer E. Cooley, W. W. DeBerard, C. E. Drayer, W. H. Finley, C. Francis Harding, A. H. Krom, Edgar S. Nethercutt, F. H. Newell, Edmund T. Perkins, J. A. Peterson, Dr. P. L. Prentis, Isham Randolph and George C. Dent.

The Government has now taken definite action designed to keep engineering students under military age in college until they complete their courses. The War Department plans to conserve this important war material through the establishment of Students' Army Training Corps in all the engineering colleges to supplement the Reserve Officers' Training Corps. Members of these organizations will be placed in the inactive service of the United States and will be classed in 5 D of the Selective Draft.

Such students will wear regulation uniforms furnished by the Government and will be required to attend training camps for a period during the summer vacations.

The draft board will not include such men in calls for induction so long as they remain in the Students' Army Training Corps.

By order of the Federal Government, the War Industries Board will supervise the filling of order of turbines of over 700 hp. This necessity grew out of a situation that developed when the Navy Department, the War Department and the Emergency Fleet Corporation were found to be competing for motive-power units, each claiming priority over the others. The twenty-one manufacturers that come under Government control have agreed not to fill orders for turbines in excess of 700 hp. for either civilian or Government purposes without a permit from the War Industries Board. It was indicated that all but a small portion of their output will be distributed between the Navy, Shipping Board and the War Department.

Detailed schedules of turbine engine requirements are being drawn up with the utmost care and will contain all necessary specifications to enable the War Industries Board to distribute the business to the best advantage among existing plants. (*The Iron Age*, vol. 102, no. 5, August 1, 1918, p. 274)

About 350 pieces of spruce are required in a single airplane. Practically all of the available spruce is in the United States and along the western coast of British Columbia. In the face of many complex problems existing in the spruce stands of the West, the Spruce Division of the Aircraft Bureau made a distinct record. In 45 days the world's largest sawmill was erected at a cost of $200,000; 1940 men operate it working in three shifts of eight hours each. A drying plant costing $350,000 was built at Vancouver Barracks and there spruce is seasoned by a kiln process worked out by the Forest Products Laboratory of the Forestry Service which effects a saving in shipping weight of 33⅓ per cent. The total spruce and fir shipped to June 15, including a large amount of each shipped to the Allies, is: spruce, 52,000,000 feet; fir, 20,800,000 feet. (*Official Bulletin*, August 7, 1918, p. 7)

The United States Fuel Administration reports a saving of coal at the rate of 350,000 tons annually in its campaign for fuel economy in steam-power plants. This saving has been initiated through the inspection of 300 of the larger plants. It is estimated that 20,000,000 tons of coal can be saved, and as fast as the work can be accomplished each of the 250,000 plants in the country will be inspected.

The Fuel Administration also announces the organization of the Industrial Furnace Section, Bureau of Conservation, to handle fuel conservation in all furnaces with the exception of those operated for the production of power, heat, and light. This includes those plants using fuel for direct heat, such as in the clay-products industries. This section is in charge of an experienced engineer who has under his immediate supervision 13 districts comprised of 31 states, covering the territory in which industrial furnaces are used. Each district has a local head who has in his organization an advisory board and a corps of inspecting engineers. A probable annual saving is estimated of 3,000,000 tons of coal.

REVIEW OF ENGINEERING PERIODICALS

SUBJECTS OF THIS MONTH'S ABSTRACTS

ALUMINUM PISTONS FOR AEROPLANE ENGINES
PRESENT GERMAN AVIATION PROGRAM
TESTING AIR COMPRESSORS
PISTON-RING FRICTION IN AIR COMPRESSORS
BRASS WEAKNESS
RED, YELLOW AND WHITE CRYSTALS IN BRASS
FLAWS IN HOLLOW FORGINGS
EXPERIMENTS ON COAL SAVING IN BOILER PLANTS
FUEL CONSERVATION ON THE SANTA FE
FOUR-CYCLE VS. TWO-CYCLE DIESEL ENGINES
AMERICAN WHALEY MARINE OIL ENGINE
GAS PRODUCERS AT CANADIAN FORD PLANT
LUBRICATION OF MICHELL BLOCKS
BROWN, BOVERI & CO. VISCOSITY TESTS
FUSION-WELDING FALLACIES
NEW TYPE OF DRIVE FOR MILLING MACHINE
CRITICAL LOADING OF STRUTS AND STRUCTURES
CLAMPING SUPPORTS AND CRITICAL LOADING
THEORY OF STRESSES IN RIGID BODY
STRESSES AS PART OF STATICS AND DYNAMICS OF RIGID BODY
SOLUBILITY OF AMMONIA
STOKES GUN AND SHELL
3-IN. ANTI-AIRCRAFT GUN, MODEL 1918
PETERSON CHASSIS LUBRICATION SYSTEM
UTILIZATION OF HEAVY FUELS IN MOTOR CAR ENGINES
AMERICAN 24-VALVE AUTOMOBILE ENGINE
LIGHT MIKADO TYPE U. S. STANDARD LOCOMOTIVE
MARTIN THEORY OF STEAM TURBINE
MODIFIED CALLENDAR STEAM CHART
TESTING OF ALUMINUM SHEETS

For Articles on Subjects Relating to the War, see Aeronautics, Engineering Materials, Machine Tools, Munitions, Varia

Aeronautics

ALUMINUM PISTONS FOR AEROPLANE ENGINES. Reprint of the official report received by the editors from the controller of the Technical Department, Aircraft Production, British Ministry of Munitions, on aluminum pistons from the 230-hp. Benz engines.

Some features are of interest. The domed head of the sand-cast aluminum piston is supported and strengthened by eight webs radiating from a central boss in the piston crown. Three cast-iron rings are fitted above the gudgeon pin and one scraper ring is provided below the gudgeon pin.

The rings are concentric and machine-hammered on the inside. They are exceptionally deep in section, being 5.25 mm. deep and only 3 mm. wide vertically. The piston-ring gap measured in position in a standard 230-hp. engine cylinder was found to be exceptionally wide, namely, 1.9 mm. The compression ratio is believed to be slightly higher in the engines fitted with the aluminum pistons than in the standard 230-hp. Benz, namely, 5.021 instead of 4.9421. (*Engineering*, vol. 106, no. 2740, July 5, 1918, p. 18, 4 figs., *d*)

THE PRESENT STATE OF THE GERMAN AVIATION PROGRAM, E. H. Sherbondy. Brief historical review of the German aviation program in the last three years with some data on its present state. The most interesting part is that referring to the tests to which new planes for military purposes are put. (*Aerial Age Weekly*, vol. 7, no. 20, July 29, 1918, pp. 961-965, illustrated, *g*)

Air Machinery

TESTING AIR COMPRESSORS, N. S. Tennant. Description of tests on a 4000-cu. ft. Belliss & Morcom (Birmingham, England) air compressor. The data are of interest in view of the scarcity of data of tests of large air compressors.

In the present instance the output of air is controlled by a valve at the compressor intake, designed to operate intermittently, completely opening and closing as required to maintain a constant air pressure in the receiver. By this method the compressor runs continuously at full load and at its highest efficiency until such time as the demand for air is less than normal, when on a slight increase in the receiver pressure the intake valve shuts completely and the compressor runs unloaded. Under this condition the first-stage air piston runs in a partial vacuum and in the second stage the air in the clearance spaces is compressed to the discharge pressure and re-expanded to the intake pressure at every stroke. The compressor therefore runs either at full load or at no load.

The compressor in question is electrically driven by a three-phase induction motor running at a constant speed of 243 r.p.m. It is of the vertical two-stage double-acting type and is directly coupled to the driving motor.

The paper describes in detail the methods of carrying out the tests. The full-load tests were carried out by coupling the compressor to a steam engine, indicator cards being taken at frequent intervals. The no-load tests were made by driving the compressor by a 50-h.p. direct-current motor previously calibrated on a Heenan and Froude water brake and directly coupled to the compressor for tests.

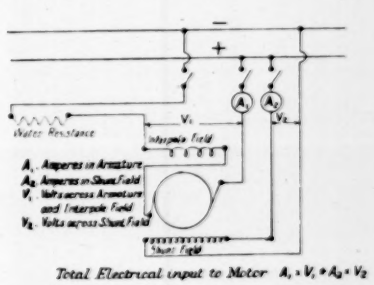


FIG. 1 DIAGRAM OF ELECTRICAL CONNECTIONS FOR TESTING COMPRESSOR AT NO LOAD BY DIRECT-COUPLED D. C. MOTOR

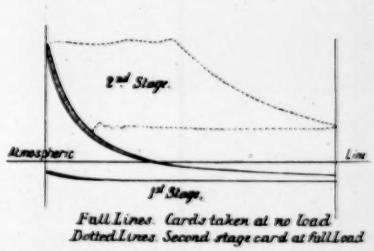


FIG. 2 INDICATOR DIAGRAMS OF SECOND-STAGE COMPRESSOR TEST
(Full Lines: Cards Taken at No Load; Dotted Lines: Second-Stage Card at Full Load)

The diagram of the electrical connections is shown in Fig. 1. The water resistance shown in the armature circuit was introduced to limit the armature current, thus protecting the motor against overloads occurring during the tests. Such protection was necessary, because if for any reason the air-inlet control valve opened during the tests, the full-load torque of the compressor would be applied to the motor.

The results of the run are shown in Fig. 3. The power at the commencement of the tests when everything was cold was, as might be expected, appreciably higher than when the normal

working temperatures were reached. The maximum power recorded at the start was 47.8 b.hp., which gradually fell with the rising temperature to the steady value of 38.2 b.hp.

Indicator diagrams shown in Fig. 2 were taken. These diagrams, among other things, show that the slip or leakage of air past the air valves is extremely small. Thus, the second-stage delivery valves have the full discharge pressure on them all the time, and any considerable air leakage would have greatly increased the area of the diagram. The temperature of the air at the compressor discharge was found to register no more than 100 deg. fahr. throughout the no-load tests. The loss due to mechanical friction alone could be deduced by subtracting the residual air i.hp. from the measured b.hp. input, which gave $38.2 - 16 = 22.2$ b.hp. As a check

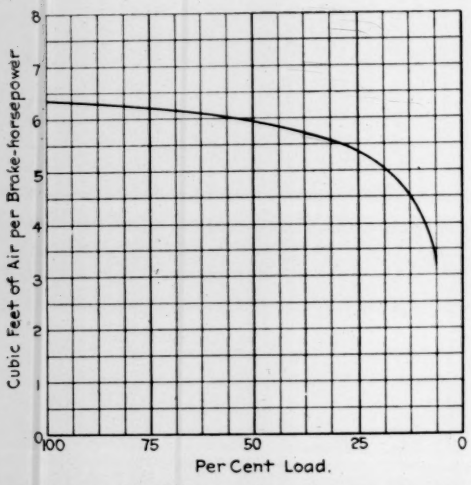


FIG. 3 EFFICIENCY OF BELLISS AIR COMPRESSOR AT VARIOUS LOADS IN CU. FT. OF AIR PER B.HP.

(Capacity, 4120 cu. ft. free air per min.; air pressure, 80 lb. per sq. in.)

on this result, the air pump was reconnected to the compressor discharge and a vacuum of about 15 in. applied. Cards taken under this condition were straight lines, no area being visible showing that the residual air hp. had been eliminated.

The input power to drive the compressor was found to be 21.6 b.hp., a result reasonably close to that deduced from the indicator diagrams. The mechanical efficiency of the compressor on the full-load test was found to be 93 per cent, which would indicate that the frictional losses increase from 3.25 per cent at no load to about 7 per cent at full load.

A further test was made to determine the loss due to piston-ring friction alone and for this purpose the first- and second-stage pistons were removed from the air cylinders. Under these conditions the power taken to drive the compressor at 243 r.p.m. was found to be 9 b.hp., this figure representing the frictional losses in the compressor bearings, main guides and metallic packing, the loss due to the piston rings alone being then $21.6 - 9 = 12.6$ b.hp., or, roughly, 58 per cent of the total friction. The piston rings were examined after the test and found to be in correct adjustment, showing a good bearing surface without being unduly tight.

The no-load losses may therefore be divided as follows:

Residual air horsepower	16.6 b.hp.
Piston-ring friction	12.6
Friction in bearings, guides and metallic packings	9.0
Total	32.2

(*Engineering*, vol. 106, no. 2740, July 5, 1918, pp. 8-9, 5 figs., *e*)

Engineering Materials

BRASS WEAKNESS, James Scott, Mem.Am.Soc.M.E. A microscopical investigation of brass purporting to throw some light on the causes of its mechanical weakness.

Broadly, the constitution of brass is divided by the author into three distinct grades; red, yellow and white. In the red, copper is predominant and the stage consists entirely or nearly so of alpha crystals which retain many of the qualities of the copper component and are soft and ductile. The yellow stages consist mostly of beta crystals which are stronger but not as ductile as the preceding. The white stages consist principally of gamma crystals and are very brittle. In the white stage zinc predominates and the crystals have a silvery luster.

One can, however, obtain, as it were, overlapping stages in which alpha crystals are yellow and the beta crystals red, the results depending on the action of certain proportions of the respective metals caused to undergo special processes.

A common brass may be composed of all three types of crystals most intimately mixed up, but it is the facility with which internal changes occur that most affects the mechanical properties of the metal.

Copper and zinc begin to separate out from the molten alloy at different temperatures and owing to the vaporizing tendencies of the zinc the routine of crystallization during solidification of the mass is seriously interfered with.

The writer makes some interesting remarks on the subject of the colors of the crystals which appear to be subject to surrounding influences. For instance, yellow alpha crystals appear as the vicinity of 71 per cent of copper is approached and the alloy is rapidly cooled. When the copper content is from 64 to 58 per cent and the alloy is cooled at 470 deg. cent., alpha crystals with the yellow tinge are exuded from the red beta crystals.

FIG. 4 CRYSTALLINE STRUCTURE OF AEROPLANE NAIL BRASS IN NORMAL STATE

A brass containing from 71 to 64 per cent of copper is, when just solidifying, made up of a mixture of alpha and beta crystals. After slow cooling, however, at 400 deg. cent. or annealing at this temperature the beta crystals become absorbed by the alpha crystals and the latter largely predominate. But further changes are possible. Beta crystals may be restored and then again vanish, especially if increase of temperature accompanies the physical action. This is why alloys con-

taining down to 60 per cent copper can only be cold-worked, while those for hot-working have to be composed of 63 to 50 per cent copper.

Commercial white brass is almost all of the gamma stage, there always being less than 45 per cent of copper present.

Rapid cooling may suppress a certain state in brass, but this is capable of prominently reasserting itself at atmospheric temperatures, the reversion being accelerated should the metal be struck or vibrated.

The writer gives illustrations taken from an etched surface (with chromic acid) of an aeroplane brass nail head. Fig. 4 shows the normal state of the metal. The grains are small and compact. Fig. 5 shows the same metal after distortion by hammering. The original grains have been forced together to form larger ones and the structure is decidedly weaker. Fig. 6 shows the same with the grains split up irregularly and crevices appear between them. This latter is due to the fact that mechanical strains and temperature variations have first caused the particles to momentarily squeeze together and after relief from the modified action to reform as much larger angular grains. The straining consequent upon such changes loosens the grains, some of which by concentration or shrinking leave crevices around their boundaries, while others gradually cleave crosswise.

This may explain the frequent dropping off of aeroplane nail heads. (*The Metal Industry*, vol. 16, no. 7, July 1918, pp. 319-320, 3 figs., *pt*)

Forge Shop

DEVELOPMENT OF FLAWS IN HOLLOW FORGINGS, A. S. Hesse. Discussion of mistakes sometimes made in the production of hollow forgings which will cause serious flaws to develop in the piece of steel being worked.

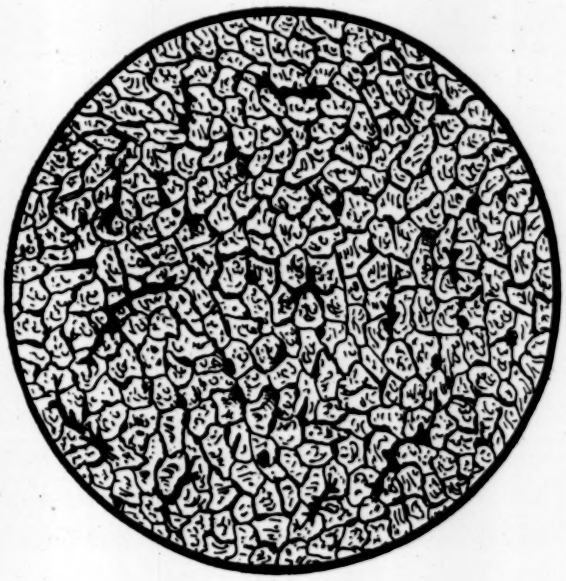


FIG. 5 CRYSTALLINE STRUCTURE OF THE SAME MATERIAL AS IN FIG. 4 AFTER DISTORTION BY HAMMERING

There are three such mistakes: namely, using too small a mandrel, using flat dies in the hydraulic press or hammer, and working the metal too cold. The first of these three is by far the most serious.

The writer shows and illustrates how the use of an excessively small mandrel may develop a fissure. The worst of it is that it is possible that this fissure may not be seen at first in the interior of a long, hollow forging until its sides are crushed together. Whether the seam so formed extends deeply into the material or not, the stress which has been developed will be a vital factor in the ultimate strength of the piece.

The flaw caused by a mandrel which is too small can hardly be avoided even where the long axis of the oval hole is placed exactly vertical, for the forging is squeezed down with a tendency to form seams on both sides.

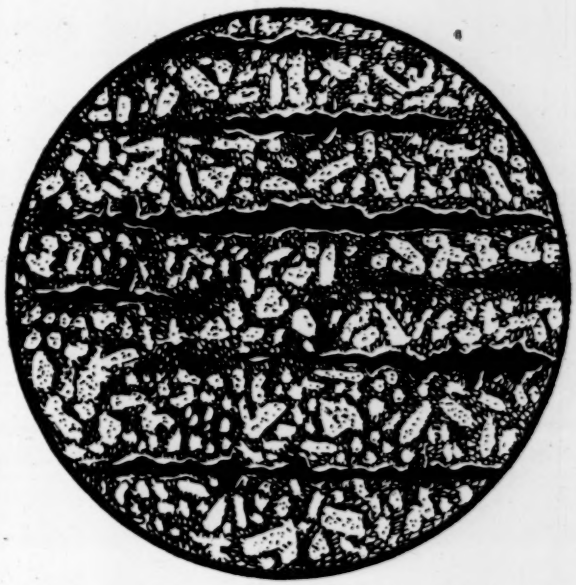


FIG. 6 CRYSTALLINE STRUCTURE OF SAME MATERIAL AS IN FIG. 4 AFTER BEING SUBJECTED TO MECHANICAL STRESSES AND TEMPERATURE VARIATIONS, SHOWING CRACKS AND CREVICES

The writer also points out that seams which were formed as very minor affairs at the start will work or "travel" along and grow deeper should the smith start going over the forging a couple of times to round it up. The best practice is to draw and finish a section and stop when it no longer draws on account of the low heat and only bends from one oval axis to another. (*American Machinist*, vol. 49, no. 4, July 25, 1918, pp. 153-154, 3 figs., *p*)

QUESTION OF QUENCHING OILS FOR FORGINGS, Geo. W. Pressell. The writer discusses under the basis of experiments the results in quenching with different oils. He claims that the quenching speed of an oil depends on its heat-conducting properties and also on its fluidity or viscosity. Decomposition of the oil entails a reduction of the quenching speed and, in general, the more viscous an oil the slower will be its quenching speed.

The most interesting part of the paper is that illustrated by Fig. 7, showing the hardening power of distilled wool grease.

Wool grease has been known for several years and is claimed to have unusual powers of heat circulation and heat absorption. It is also claimed that it does not decompose after repeated use or show indications of further fractional distillation.

Tests were made for quenching speed at different temperatures. The test piece was made from low-carbon chrome-vanadium steel 17 in. long and 3¼ in. wide. All heating was done in lead and the test piece was heated to 1200 deg. fahr., then quickly immersed to a constant depth in 25 gal. of the quenching fluid, the immersion being such that the quenched mass was equally surrounded on all sides by the same depth of quenching fluid. A stop watch was used to measure the

time required to cool the steel from 1200 to 600 deg. fahr. The following data were obtained with distilled wool-grease oil:

Temperature of quenching bath, deg. fahr.	Seconds.	Temperature of quenching bath, deg. fahr.	Seconds.
82	97	190	102
97	99	202	102
112	102	215	105
125	104	222	106
138	103	230	104
149	102	238	105
160	101	245	103
170	101	249	102

The average quenching speed was 102 sec. The total variation was 9 sec.

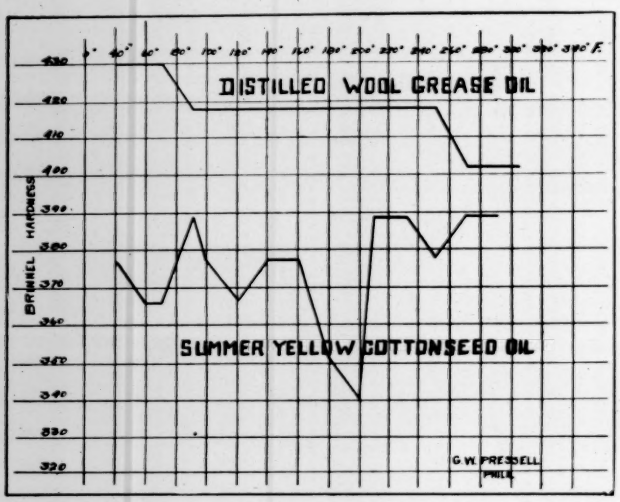


FIG. 7 CURVES SHOWING HARDENING POWER OF DISTILLED WOOL GREASE AND YELLOW COTTONSEED OIL

Tests were also run on heat conductivity, oxidation and volatilization of various oils, as well as a test to determine the life of oil distilled from wool grease and the effect of constant use.

The system of quenching with its appliances, such as quenching tanks, cooling of the oil, etc., are discussed in brief. (Paper presented at the Fifth Annual Convention of the American Drop Forge Association, abstracted through the *American Drop Forger*, vol. 4, no. 7, July 1918, pp. 273-277, *ep*)

Fuel and Firing

COAL SAVING BY THE SCIENTIFIC CONTROL OF STEAM-BOILER PLANTS, D. Brownlie. The first of a series of articles promising to be of quite unusual interest.

It is proposed to give the average figures for 250 typical steam-boiler plants covering the period from 1910 to the present time with the object of supplying accurate data on possibly conservation of fuel through the adoption of scientific methods in the boiler house.

The present article describes the method of carrying out the tests and begins the detailed analysis of the results of the 250 tests. (*Engineering*, vol. 106, no. 2741, July 12, 1918, pp. 25-27, *epA*, To be continued)

FUEL CONSERVATION ON THE SANTA FE, Charles E. Parks. Description of the methods used in the past ten years for fuel conservation on the Santa Fe system.

In 1909 over 3½ billion lb. of coal were consumed in producing approximately 16 billion gross ton-miles; in 1917 the gross ton-miles had increased 55.9 per cent, while the pounds of coal used had only increased 17.8 per cent. The pounds of coal consumed per 1000 gross ton-miles was 227 lb. in 1909 and 171 lb. in 1917, or a decrease of 24.7 per cent.

It is recognized that this decrease in fuel consumption was due to many factors outside of the activities of the fuel department of the individual railroad system: such as the proper design and maintenance of locomotives; the use of larger power plants; construction of second tracks; reduction of grades; elimination of curves and general improvements in the line; lengthening passing tracks and greater efficiency in train handling.

The Santa Fe fuel department works along two general lines: first by educating the actual users of the fuel in its economic use, and second by an inspection and supervision of the physical factors in fuel consumption.

The education of the enginemen and the firemen has been materially assisted by a system of fuel accounting which not only discloses the conditions as they exist at the fuel stations daily, but also shows the amount of fuel consumed by each individual engine on each trip. In addition to the engine crews, much effort has been made in educating the fire builders, fire cleaners, hostlers and helpers in roundhouses. Further, the fuel question on the Santa Fe is recognized as something in which the transportation department is interested as well as the mechanical department. Dispatchers are constantly impressed with the importance of economic fuel consumption in handling trains and it is also forcibly brought to the attention of conductors, trainmen and other operating employees. The inspection department sees to it that the coal is free from slate both at the mines and at the fuel stations. The operation of coal chutes is under the supervision of the department and all coal-chute foremen and laborers are carried on the department roll. Attention is also given to the unloading of coal and the loading of engine tanks to prevent waste in yards and along the right of way.

The article describes in detail the system of accounting, and, in particular, the individual fuel records.

The writer sums up the whole situation by saying that waste in fuel like loss and damage claims cannot be reduced to zero, but the record of the Santa Fe shows that it can be materially reduced when a systematic effort is made. (*Railway Review*, vol. 63, no. 4, July 27, 1918, pp. 124-127, *p*)

Internal-Combustion Engineering

FOUR-CYCLE VERSUS TWO-CYCLE DIESEL ENGINES. Discussion of the relative merits of these two principles as applied to Diesel engines.

It is generally admitted that the larger the power the better is the case for the two-cycle principle; and furthermore, the Diesel engine is free from some of the most severe objections to the two-cycle principle. Thus, scavenging with Diesel engines is carried out by air alone and not by a mixture of air and gas, which eliminates the danger of ignition of the incoming gas or of the loss through the exhaust ports of part of the charge.

Franco Tosi, of Milan, Italy, have recently built two similar engines; one a two-cycle and one a four-cycle, which they have tested one against the other with a view to comprehensive comparison.

The two-cycle engine has six working cylinders in the center with a scavenging pump and a compressor at each end. The four-cycle engine has eight working cylinders with two compressors at the forward end. There are also other differences required by the respective cycles of operation.

Both engines are of the same b.hp., namely, 1300, which is the standard submarine-engine size of the makers.

Lengthy tests were carried out, 145-hour continuous non-stop runs being made and both engines developed their designed power of 1300 b.hp. at 300 r.p.m. It was found, however, that the two-cycle engine was not capable of developing higher than this figure, whereas the four-cycle engine at the same speed gave 1450 b.hp. and as a ma imum power at higher revolutions developed 1585 b.hp. for a short period. As regards fuel and lubricating oil consumption, the advantage lies greatly in favor of the four-cycle engine. At full load the four-cycle figure was 0.41 lb. of fuel and lubricating oil per b.hp. hour, whereas the two-cycle consumption was 0.573 lb. per b.hp. hour.

It is of interest to note that with the two-cycle engine at 300 r.p.m. the compression was 460 lb. per sq. in., whereas at 120 r.p.m. the compression fell to 315 lb. per sq. in., at which pressure the temperature would be insufficient to support combustion of heavy fuel oil and so the engine would stop. With the four-cycle engine at 300 r.p.m. the compression pressure was 490 lb. per sq. in. and at 100 r.p.m. had fallen only to 445 lb. per sq. in.

Messrs. Franco Tosi have decided, in future, to abandon the two-cycle principle, and to confine themselves to the four-cycle for reasons substantially as stated, which may finally be recapitulated: 1. Elimination of the scavenging air pumps with their receivers, diminishing thus the size of the engine and decreasing the noise. The four-cycle engine of equal power is, approximately, the same size and weight as the two-cycle. 2. Lesser amount of heat units abstracted by the cooling water and the four-cycle engine contributing to the lower-fuel consumption with the four-cycle engine. 3. The inefficiency of scavenging with two-cycle engines, as compared with the four-cycle. 4. The possibility of using higher piston speeds with the four-cycle engine. 5. Greater flexibility of the four-cycle engine. 6. Simpler mechanical parts of the four-cycle engine. 7. The fuel pumps and valve gear of the four-cycle engine only ran at half the engine speed, making thus for easy running conditions. (*Engineering*, vol. 105, no. 2739, June 28, 1918, pp. 727-728, editorial)

"GASTEAM" PLANT AT FORD CITY, ONTARIO. Description of the combination gas and steam plant now being erected by the Ford Motor Company of Canada, Ltd., on the Canadian side of the Detroit River at Ford City, Ontario.

On the whole the plant follows closely in design the general arrangement of the well-known Highland Park Plant in Detroit, where boiler feedwater is employed to recover waste heat from gas-engine cylinder jackets.

One of the most interesting features of the plant is in the gas-producer installation where tar separated from the gas is returned to the producer and gasified. It is stated that this method of tar disposal proved to be preferable to the old system of burning the tar under the boilers, as the heat value of the gas is increased considerably when the tar is gasified.

At present there are two Smith gas producers and a third is being installed. Each producer is built up in six sections. The rate of driving in each section can be separately controlled so as to prevent channelling and unequal blast distribution in the fuel bed.

As regards the operation of the producer plant, the following information is given: On leaving the fire the gas passes through a brick-lined hot pipe to a primary cooling tower where its temperature is reduced from about 1100 deg. fahr. to 120 deg. fahr., or to a temperature that will insure efficient operation of the tar extractors. It then passes through a low-pressure header into the exhauster, which delivers the gas under 3 lb. pressure to the tar extractors. After the tar is removed the gas enters the secondary cooling tower where the temperature is reduced to approximately that of the atmosphere before being delivered to the gas engines and to furnaces in the shop.

The fuel bed in the producers lies at an angle of 35 deg. and when the grates are shaken the fuel moves obliquely along the inclined bed. Three firemen on top of each producer watch closely for holes, channels and ridges in the fuel bed, particularly along the wall. The depth of the fuel bed averages about 5 ft. on the high side of the grade and 7 ft. along the back wall.

Exhaust steam is used to saturate the air blast to the producers. A thermostatic valve automatically controls the steam supply so as to maintain the temperature of the blast at 140 to 150 deg. fahr.

In the operation of the thermostatic valve a curious phenomenon was discovered. The valve had been adjusted to open and close slowly, gradually changing the quantity of steam being admitted to the producer. By regulating it so that it would open and close at the rate of two times per minute, admitting the steam in puffs, the proportion of carbon monoxide could be maintained at 25 per cent and the carbon dioxide cut down to 3½ per cent. The probable explanation for this is that in the first place steam coming in contact with incandescent carbon forms water gas high in carbon monoxide. As the motor-operated valve closes the decomposition zone increases rapidly in temperature, as only dry air is entering the combustion zone. When the valve opens it allows a considerable quantity of steam to enter and strike the incandescent carbon, which again forms water gas, with the result that the producer gas is made high in carbon monoxide.

Some trouble was at first experienced with tar delivery. At first the tar pipe was jacketed, but this was found to be unnecessary, for when the tar is recirculated it becomes as fluid as machine oil. A 2-in. line without steam jacketing is now used and the pumps have been replaced by a steam-pressure tank with steam at 880 lb. pressure. At first tar from the sprays tended to saturate the fuel bed, but this trouble was overcome by increasing the number of spray nozzles from three to five and thus distributing the tar more evenly over the fire. The gain in thermal efficiency by gasifying the tar averages from 8 to 9 per cent. (*Power*, vol. 48, no. 6, August 6, 1918, pp. 186-193, 13 figs., *d*)

Lubrication

THE LUBRICATION OF MICHELL BLOCKS. A mathematical discussion of the problem. In the applications which have hitherto been made of Osborne Reynolds' theory of lubrication, it has been customary to assume that the viscosity of the lubricant does not vary as it passes through the bearing. On this assumption it follows that for efficient lubrication a Michell block must be supported behind its center of figure in order to secure the necessary film of oil between the opposing surfaces; and, moreover, such a block, if centrally supported, should have no load-carrying properties whatever. By actual experiment it was found, however, that a centrally pivoted block could carry quite a high load and it was pointed out by H. T. Newbigin, in 1914, that this was due to the fact that in applying Reynolds' theory the variation of the viscosity of

the oil as it rose in temperature during its passage through the bearing was neglected, and that when this factor was taken into account the experimental facts were quite in accord with theory.

For a block infinitely wide as compared with its length, measured in the direction of motion, Osborne Reynolds gave the equation:

$$\frac{dp}{dx} = -6\lambda \frac{h - h^1}{h^3} \quad \ldots\ldots\ldots\ldots\ldots\ldots [1]$$

where p denotes the pressure of the oil, x the distance of any point of the block from the origin, λ the viscosity of the lubricant, while h denotes the distance separating the opposing surfaces at any point x, and h^1 is the value of h at the point where the pressure is a maximum.

In integrating this equation Osborne Reynolds assumed λ to be constant, although it is known that the temperature of the oil may be increased by its passage under the block. Some time ago this subject was investigated theoretically and experimentally in the laboratories of Brown, Boveri & Co., of

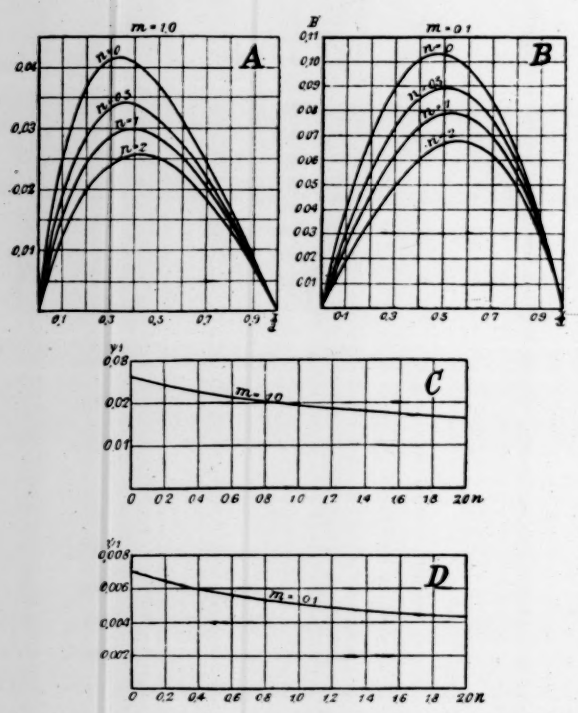


FIG. 8 CURVES FROM TESTS ON LUBRICATION OF A MICHELL BLOCK

Baden, Switzerland. In this investigation the assumption was made that the viscosity λ may be expressed in the form

$$\lambda = \lambda_0\left(1 + \frac{n}{a}x\right)$$

Here λ denotes the viscosity of the oil as it *leaves* the block, while a denotes the length of the block and n is a coefficient. The viscosity of the oil as it enters the block is therefore $(1+n)\lambda_0$.

With this substitution Equation [1] can still be easily integrated and the results for practical values of the constants m and n are given in Fig. 8, *A* and *B*, taken from the house organ of Brown, Boveri & Co. called *Revue B.B.C.* In these figures m is defined by the relation $h = h_0\left(1 + \frac{mx}{a}\right)$ where a is, as before, the length of the block taken in the direction of motion and m represents the inclination of the block to the other bearing surfaces.

It appears from Fig. 8-*A* that when $n = 0$, that is to say, when the viscosity is constant, the maximum pressure and the line of action of the resultant pressure lie distinctly behind the center of the block.

Fig. 8-*B* corresponds to a much smaller angle between the opposing bearing surfaces and in this case the change in viscosity has a much greater influence on the position of the center of pressure. This becomes nearly coincident with the center of the block when the viscosity is only 50 per cent more at the leading edge than at the trailing edge, while with $n = 2$ the center of pressure is well forward of the leading edge.

The two curves appear to indicate that to carry a given load the oil film will be thinner with a centrally pivoted block than with one which is pivoted behind the center line. This thinner film will be subject to a more severe shearing action and the development of heat should be greater than with the center of pressure behind the center of the figure.

The Swiss investigators have also determined the total load carried per unit width of an infinitely wide block when the viscosity varies according to the law already assumed above. Denoting this total load by $\frac{P}{b}$, they find that:

$$\frac{P}{b} = \frac{6\lambda_1 U a^2}{h_0^2} \cdot \varphi_1$$

where $\lambda_1 = \lambda_0(1+n)$ denotes the viscosity of the oil at the leading edge, λ_0 being the viscosity at the trailing edge. U is velocity of motion, h_0 the least thickness of the film and a the length of the block measured in the direction of motion. The function φ_1 depends on n and m only. Its value for different values of n when $m = 1$ is given by Fig. 8-*C*, and when $m = 0.1$ is given by Fig. 8-*D*. Fig. 8-*C* shows that if the viscosity is three times as much at the leading edge as at the trailing edge the load carried is only about eight-thirteenths as much as if the viscosity were constant at its highest value. With $m = 0.1$ the relative carrying power diminishes with varying viscosity in approximately the same degree as with $m = 1$.

The original article describes tests made to determine the truth of the above conclusion and also experiments on the coefficient of friction.

In conclusion, the writer in the *Revue B.B.C.* points out that Michell's calculations show that when a block is of finite dimensions the displacement of the center of pressure from the center of figure becomes greater the narrower the block is as compared with its length in the direction of motion. The effect of side leakage is therefore to increase the eccentricity of the resultant pressure on the block, while on the other hand the rise in the temperature of the oil tends to decrease this eccentricity. (*Engineering*, vol. 105, no. 2739, June 28, 1918, pp. 714-715, 4 figs., *et*)

Machine Shop

FUSION-WELDING FALLACIES, S. W. Miller. Continuation of an article the first installment of which appeared in the July number of *Machinery*. The writer discusses here several of the commonly accepted but erroneous opinions about fusion welding. He points out that a weld which has not been heat-treated is not suitable for all engineering structures; that thermal changes in structures are neither negligible nor easily corrected: that coarsening of the grain reduces the ductility and resistance to shock of the metal, and these conditions cannot be entirely overcome by heat treatment although a material improvement can be made.

The structure of weld cannot be made as good as that of the original material, because the finest grain and therefore the

best physical qualities can only be obtained by using both heat treatment and some mechanical treatment like forging. As forging cannot be done in most welds it is evident that the best results cannot be secured. An electric weld in the opinion of the writer is not superior to an oxy-acetylene weld. (*Machinery*, vol. 24, no. 12, August 1918, pp. 1082-1084, 11 figs., *cp*)

Machine Tools

MILLING MACHINE WITH NEW TYPE OF DRIVE. Description of a constant-speed driven type of milling machine in which 16 changes of spindle speed and the same number of feed rates are available, all of which changes are obtained through sliding gears controlled by two ball-joint levers, the tumbler gear in the feed-change mechanism having been eliminated. The power is transmitted through a single driving pulley operating at a constant speed and all the shifting of gears is done on secondary shafts underneath. (*The Iron Age*, vol. 102, no. 4, July 25, 1918, p. 207, 1 fig., *d*)

Mechanics

CRITICAL LOADING OF STRUTS AND STRUCTURES, W. L. Cowley and H. Levy. Many interesting questions of practical importance relating to the failure of structures under compression have been brought up by a study of the problems of the strength of aeroplane framework. The present paper is an attempt to solve problems relating to the strength of such a construction as a beam under end thrusts, supported at intermediate points.

The writers believe that there are two types of failure of a structure. On the one hand, the material of a member may rupture on account of the yield stress having been exceeded during the course of the loading; while, on the other hand, the loading may be such that the geometrical configuration previously existing can no longer be maintained even approximately. It is the second type of failure which forms the chief subject of discussion in this paper. The writers start with the discussion of an elementary case such as, for example, when a prismatic homogeneous rectilinear uniform strut with simple supports at the end is loaded both laterally and longitudinally, as in Fig. 9.

AB is the strut simply supported at the ends A and B. Let w (pounds per unit length) be the intensity of lateral loading at P of coördinates x and y. Let M_1 and M_2 be externally applied bending moments at the ends. The writers consider the equilibrium of the beam taking the origin at A and AB as the axis of x.

The bending moment at P is given by

$$F.y - M_2 + (M_2 - M_1)\ (l-x)/l + H(x)$$

where $H(x)$ is the bending moment at P due to the lateral loading alone. Equating this to the resisting moment, viz., $-EI$ (curvature), and assuming the deflections small, we find that

$$-EI\frac{d^2y}{dx^2} = F.y - M_1 + (M_1 - M_2)x/l + H(x) \ldots\ldots [1]$$

where $H(x)$ does not involve M_1 and M_2.
This equation may be written

$$\frac{d^2y}{dx^2} + \lambda^2 y = M_1\lambda^2/F - x\lambda^2(M_2 - M_1)/Fl - \lambda^2 H(x)/F \ldots [2]$$

where $$\lambda^2 = F/EI \ldots\ldots [3]$$

From this the writers proceed to show that the bending moment at any point can only become infinite when

$$\sin \lambda l = 0 \ldots\ldots [8]$$

unless at the same time

$$M_1 \cos \lambda l - M_2 + F\left\{X(0)\cos \lambda l - X(l)\right\} \longrightarrow 0 \ldots\ldots [9]$$

Equation [8] indicates that when the length of the strut is given by

$$\lambda l = \pi$$

that is, $$l = \pi\sqrt{(EI/F)} \ldots\ldots [10]$$

bending moments and deflections become excessively large compared with those allowable by the analysis. Equation [10] is the commonly recognized expression for "Euler's strut."

It should be particularly noted that under these conditions Equation [9] reducing to

$$M_1 - M_2 = -F\left\{X(0) + X(l)\right\} \ldots\ldots [11]$$

furnishes a relation between the externally applied bending moment which may prevent the struts failing in the Eulerian sense. It is suggested that in a structure in which M_1 and M_2 are determined by the loading and configuration of the system, it may be possible to have present a strut of Euler's length without failure resulting.

It appears then that in the simple case treated above, a

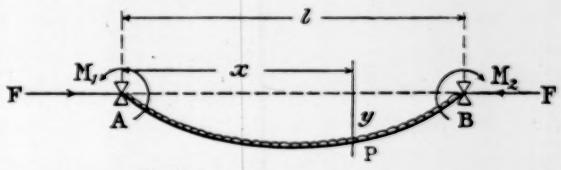


FIG. 9 PRISMATIC HOMOGENEOUS RECTILINEAR UNIFORM STRUTS WITH SIMPLE SUPPORTS AT THE ENDS LOADED BOTH LATERALLY AND LONGITUDINALLY

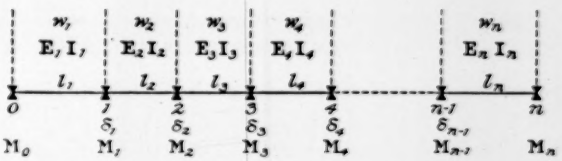


FIG. 10 BEAM WITH $n + 1$ SUPPORTS

critical loading of the beam is essentially associated with the production at all points of bending moments and deflections excessively large in comparison with those allowable by the assumption upon which the analysis is based.

This immediately suggests that failure, in a corresponding sense, may take place in a more complicated structure and that these criticals will be furnished from the expressions determining the bending moments on the assumption of small deflections by inserting the condition that the former become infinite.

The next case discussed is that of a uniform beam under end thrusts, where the central axis is constrained to pass through $n+1$ fixed points. For this case formulæ are derived, by means of which the loads on each bay are defined in terms of the dimensions of the bays, their flexural rigidities and the longitudinal loading in addition to the lateral loading. Thus is given an extended form for the equation of three moments, or Clapeyron's theory, when the axis of the beam is constrained to pass through given points and when both lateral and longitudinal loading exist.

Next is considered the case of $n+1$ supports and n bays figured in such a manner that the rth bay appears to the left of the support numbered r as in Fig. 10. For this case a system

of equations is obtained from which if the bending moments at any two supports (usually zero and n) be known the remaining bending moments are uniquely determined, and once the bending moments at all supports have been evaluated the determination of the bending moment in each bay becomes a simple matter.

The next matter inquired into is the suggestion that the presence of a bay of Euler's critical length would not of itself involve failure of the type here considered. In common engineering practice failure is often assumed to be the case.

The writers sum up this case in the following manner: A beam supported at any given number of simple supports will not fail in general through the bending moments becoming excessive, even if some of the bays are of Euler's critical length, provided one bay, at least, is not of this length. Whether or not this will correspond with the stable loading of the structure will depend on whether or not the actual longitudinal load, if any, that would produce infinite bending moments is greater or less than Euler's load for the bays in question. It appears, therefore, that the presence of bays of Euler's length is not in itself either a necessary or sufficient criterion for instability.

On the other hand, where one of the bays is twice Euler's length, the writers find that the equation giving the relation between the bending moments contains an infinite term, and since the coefficients of these bending moments and the remaining terms are all finite, it follows that one, at least, of the bending moments must become infinite and the structure must fail. This is, however, not the lowest critical loading.

The following statement is made as to the conditions of failure of a supported system:

The criterion of failure which will be utilized in the present discussion is, as already explained, the production of infinite binding moments at the supports. Associated with this will be the assumption already known to be valid in the case of a single strut, that for values of the longitudinal force greater than the least that will produce these infinite bending moments, the geometry of the structure will not be maintained, the failure, in this sense, thus corresponding with instability. It remains, therefore, to write down the mathematical expression which must be satisfied when the bending moments are infinite and to determine the least root, regarding it as an equation in F, the longitudinal force.

The case of clamping supports is considered in detail, two cases being specially inquired into, namely, where the beam is clamped at either or at both ends, and determinational conditions corresponding with critical loading are given. On the whole, the writers believe that clamping one or both ends is equivalent to a direct addition of strength, the exact magnitude of this increased safety being dependent upon the smallest root of the determinant regarded as an equation in F, the longitudinal force. (Paper read before the Royal Society, January 2, 1918, abstracted through the *Proceedings of the Royal Society*, Series A, vol. 94, no. a662, pp. 405-422, 7 figs., *tA*)

A DOCTRINE OF MATERIAL STRESSES, R. F. Gwyther. The purpose of the paper is to provide a reasoned basis for a theory of stresses applicable in the first case to a body which satisfies the geometric conditions for acting as a rigid body (not being in a state of constraint), but which shall be capable of extension to elastic bodies or to other approximations to natural bodies without introducing the fiction of an "undisturbed" condition in which the body is assumed to be free from stress.

The body contemplated is not supposed to be crystalline, fibrous or annealed and not to be subject to any special conditions either locally or at the surface.

The general reasoning is expressed by the writer in the following manner:

(1) The nine elements of mechanical stress obey well-known laws of resolution. By introducing the notion of infinitesimal rotations of the coördinate axes about their own positions, we can, for our present purposes, replace these relations by the three differential operators, acting upon the elements of stress, the determination of which follows from the laws of their resolution; that is, these operators are based on mechanical considerations.

(2) If we now consider any arbitrary vector (which we shall speak of conveniently as a virtual or potential displacement), we may look upon the nine first differential coefficients of its components as being replaced by the nine elements of virtual or potential strain (including among them the three rotations).

These nine virtual strains may now be affected by the same infinitesimal rotation of the axes as is employed in (1), and the three consequent differential operators acting upon the elements of strain may be deduced; in this case on geometrical grounds. It will be noticed that the forms of the two sets of operators are similar, and may easily be made identical.

(3) I shall now introduce the fundamental assumption on which the theory is based: namely, that the elements of a material stress are functions of the first differential coefficients of the components of some vector quantity; in other words, functions of some set of nine virtual strains.

(4) If we now turn to the two sets of differential operators concerning elements of stress and of virtual strain, we are able, in consequence of assumption (3), to express each element of stress in terms of the nine elements of virtual strain; or conversely, each element of strain in terms of the nine elements of stress, by means of sets of simple partial differential equations.

In obtaining these solutions constants will be regarded as uniform and isotropic, and, consequently, we shall exclude, among other things, the possibility of a crystalline structure. We shall also suppose the body not to be in a state of constraint, or otherwise that that state has been eased. I shall, further, limit the solutions to relations of a linear form. From this it will follow that the relations between the elements of stress and of virtual strain agree, in form, with the corresponding relations familiar to us in the Theory of Elasticity.

(5) Supposing the elements of virtual strain to be expressed in terms of the elements of stress, we may eliminate the former by differentiation, and obtain a set of relations involving only the elements of stress (stress relations).

(6) I shall now suppose the set of three mechanical stress equations to be introduced which correspond to the state of rest or motion of the body as a rigid body. With these equations I shall suppose the stress relations of the preceding paragraph to be combined. From this combination we may obtain stress relations, by which we may regard the elements of stress to be defined: as far as they are capable of being defined as long as the surface-traction conditions have not been considered.

(7) Up to this point I have been contemplating such cases as a cube of metal on a rough inclined plane, or a connecting rod moving in a prescribed manner, the geometrical conditions for rigidity being preserved. The stresses are not to be regarded as undefined, but as being determinate.

(8) The Theory of Elasticity is now introduced by the definition of an elastic body as a body such that the strain, hitherto considered as a virtual or potential strain, is the actual strain

experienced by the parts of the body. The stresses being definite, the strains become definite, and the displacement may be deducted.

The acceptance of the principles involved in this doctrine would have the effect of removing the subject of stresses from its accepted place in the Theory of Elasticity, and of making it an integral part of the Statics and Dynamics of a Rigid Body. (*The London, Edinburgh, and Dublin Philosophical Magazine and Journal of Science*, vol. 35, no. 210, June 1917, pp. 490-492, *tA*)

Motor-Car Engineering

UTILIZATION OF HEAVY FUELS. As a result of some experiments which he conducted, the author believes the concentration of effort toward the most suitable application of additional heat to vaporize the fuel, to be undesirable. In his estimation it is necessary to endeavor to atomize the fuel more thoroughly than is generally the case in modern carbureting devices. The specializing upon the provision of heat may give satisfactory results if the problem be looked upon only from one aspect, merely to secure the complete vaporization of the fuel, but where excessive heat is solely depended upon, the end in view is attained at the expense of the volumetric efficiency of the engine.

From the particulars which have been published of certain American vaporizing systems, it appears that in the United States efforts are being directed toward the application of heat to the heavier elements only of the fuel which may be passing in unvaporized form from the carburetor to the cylinder ("hot spot" devices).

If a certain temperature is necessary to vaporize the fuel in the form in which it issues from the carburetor jet, it is obvious that more complete vaporization would occur if the same heat were applied to a more thoroughly atomized fuel. Experiments which the author made led him to believe that in the case of fuels which are not excessively heavy, judged by the present standards, it is possible to obtain better results in the way of power production and economy by thoroughly atomizing the fuel, even without the provision of hot air or hot-water jackets, than by depending upon heat alone to vaporize it. (Editorial in *The Autocar*, vol. 41, no. 1185, July 6, 1918, pp. 1-2, *g*)

A NEW CHASSIS LUBRICATION SYSTEM. Description of a scheme by which oil in a motor car is fed to bearings by wicks. The wicks are suspended in a reservoir of oil through a conical-shaped hole. At the small diameter of the conical hole a sharp edge is provided which acts as a barb, gripping the wicks tightly and making it impossible to pull them out from the outside.

The oil is fed to the surfaces to be lubricated by means of capillary attraction and can be regulated in the following manner: The point where the sharp edge of the small diameter of the conical hole grips the wick compresses it and this compression is varied in accordance with the amount of lubricant required for a bearing surface. When there is no relative motion between the bearing and its journal there is no flow of lubricant, as it is the movement of one surface relative to another that causes the oil that has saturated the wick to be wiped off and become distributed over the bearing surface.

In Fig. 11 a brake-countershaft assembly is shown in which oil is employed for lubrication though not on the system above described. The trunnion bearings shown eliminate any chance of the brake countershaft and tube binding from frame weave when the truck is passing over irregular road surfaces. (*Automotive Industries*, vol. 39, no. 3, July 18, 1918, pp. 95-96, 5 figs., *d*)

24-VALVE AUTOMOBILE ENGINE. It is stated that the Pierce Arrow Motor Car Company is going to place on the market an automobile equipped with a 6-cylinder 24-valve engine. While four valves to an engine is not new, and both the Stutz and the White companies are using them as standard equipment, a 6-cylinder engine with four valves to a cylinder is new commercially. (*Automobile Topics*, vol. 50, no. 12, July 27, 1918, p. 1193, *g*)

Munitions

THE STOKES GUN AND SHELL AND THEIR DEVELOPMENT, Sir Wilfred Stokes. Third Gustave Canet lecture delivered

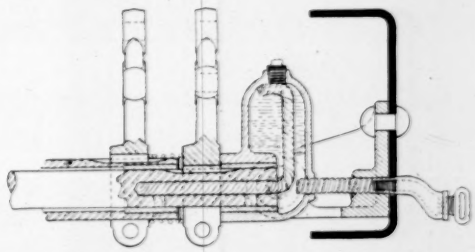


FIG. 11 BRAKE-COUNTERSHAFT ASSEMBLY IN WHICH OIL IS EMPLOYED AS A LUBRICANT

before the Junior Institution of Engineers on Monday, June 24, 1918, giving the history of the Stokes trench mortar. The article is of considerable interest as it explains not only the actual construction of the various parts, but also the ideas underlying their design in connection with this novel application. The paper is illustrated by halftones. (*Engineering*, vol. 105, no. 2739, June 28, 1918, pp. 719-723, 20 figs., *d*)

THE 3-IN. ANTI-AIRCRAFT GUN, MODEL 1918. The first description of this interesting apparatus. The gun is built up of nickel-steel forgings consisting of a tube, jacket and bridge ring assembled by shrinkage.

The gun weighs 1948 lb., has a total length of 129.69 in. and a length of bore of 4 calibers, equivalent to 120.04 in.

The weight of the projectile, shrapnel type, is 15.95 lb. and the muzzle velocity is 2400 ft. per sec. (*The American Machinist*, vol. 49, no. 5, August 1, 1918, pp. 185-190, 5 figs., *d*)

Physical Chemistry

THE SOLUBILITY OF AMMONIA, M. J. Eichhorn. An extensive article reviewing in detail the previous work done on the subject.

The numerical data previously obtained have been plotted on a Cartesian diagram, Fig. 12, which illustrates the outstanding discrepancies in the values collected from various sources and permits the estimation of the magnitude of the probable errors.

From this diagram it appears that at ordinary room temperatures the agreement between the values for atmospheric pressures is fairly good, but for temperatures near the freezing or boiling point, or for pressures considerably above or below the atmospheric, the few data available are far from being in harmony.

The lines of equal pressure in the right half of the diagram

seem to converge toward a point located below the lower right-hand corner, and in order to investigate this matter further the diagram was anamorphosed and the scale for t recalculated, so as to make the line for $p = 1.0333$. The end points were taken at $t = 0$; $N = 1202.8$; and $t = 102$; $N = 0$; the scale for N was left as a regular scale. Now, calling x the distance, measured on a regular scale, from the point $t = 0°$ to the point $t°$, it follows from the proportionality of the sides in the two right-angled triangles, that

$$1202.8 \div 102 = (1202.8 - N) \div x; \text{ from which}$$

$$x = 102\,[1 - (N \div 1202.8)]$$

With the scale for t determined by the last equation, and the

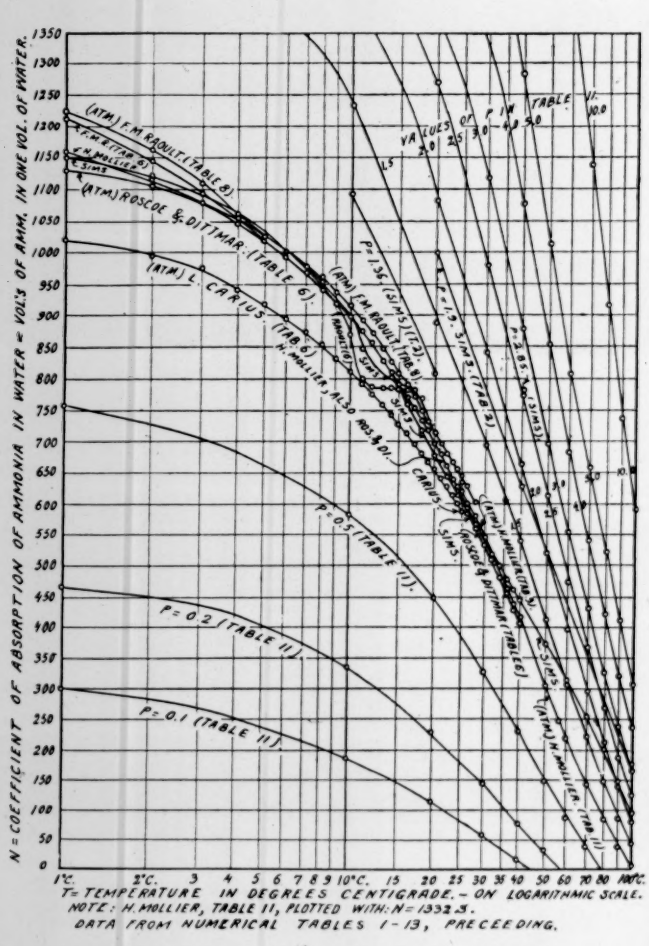

N = COEFFICIENT OF ABSORPTION OF AMMONIA IN WATER = VOLS. OF AMM. IN ONE VOL. OF WATER.
T = TEMPERATURE IN DEGREES CENTIGRADE. - ON LOGARITHMIC SCALE.
NOTE: H. MOLLIER, TABLE II, PLOTTED WITH N = 1332 S.
DATA FROM NUMERICAL TABLES 1-13, PRECEEDING.

FIG. 12 DIAGRAM FOR SOLUBILITY OF AMMONIA

same regular scale for N, a new Cartesian diagram is constructed and the lines of equal pressure, plotted on such a system of coördinates, prove to be reasonably close approximation to straight lines and meet in one point, diagonally below the lower right-hand corner.

The diagram was further anamorphosed into one with three groups of intersecting parallel lines by a method which the author believes to be original with him. It is a method of perspective geometry and consists essentially in rejecting the point of radiation to infinity. If we consider the eye located in the plane of the last-mentioned diagram, and in the point in which the equal-pressure lines coincide, and further that the plane of the diagram is intersected by another plane, at right angles to the same and also at right angles to the line connecting the eye with the zero point of the diagram, and beyond the latter, then each numbered point on the coördinate axis may be considered as having a perspective image on the new plane. These image points, taken together, form two scales for N and t, and when the eye point is considered as receding to infinity, then of course all the lines, connecting each image point with the same, become parallel. When the new scales for N and t thus obtained, are taken as the coordinate axes in another Cartesian diagram, the lines of equal pressure, plotted on same, will be straight parallel lines. In this diagram the scale for N is a linear scale, the general equation for which is

$$x = (ma + n) \div (pa + q)$$

In order to convert the last-mentioned Cartesian diagram into a nomogram of aligned points, Fig. 13, the equation of the N-scale, obtained by the method outlined above, was figured out by taking four arbitrary points and forming four equations with m, n, p, q as the unknown quantities and solving for the same. The resulting formula for the N-scale is

$$x = 26\,a \div (a + 2100)$$

Again utilizing the relation $N = 1332\ S$, the equation of the S-scale becomes

$$x = 51.8\,a \div (a + 1.568)$$

in which

a = number of the point

x = distance of the point from zero

S = fraction of a pound of ammonia to one pound of water.

The writer constructed a second nomogram for solubility of ammonia in which the Mollier equation of condition is laid as a basis, with the results given in both the customary and the metric units. (*Ice and Refrigeration*, vol. 55, no. 2, August 1918, pp. 41-47, 6 figs. of which 3 are tables, *tA*)

Power-Plant Engineering

DETERMINATION OF HEAT GIVEN OFF BY ENGINES AND POWER PIPING, Dr. E. V. Hill and W. J. Mauer. Some time ago the Engineering Department of the City of Chicago requested the Ventilation Division of the Health Department to conduct tests with the view of determining the amount of heat supplied to the engine rooms of pumping stations by the engines and power piping in the building.

In order to determine the net heat supplied by the equipment it is necessary to determine the air change in the building under average winter conditions, and one must also know the heat loss from the building due to temperature differences on the inside and outside of engine-room walls.

The article describes in detail the method of carrying out the tests. The air change in the engine room was determined by the reduction of the carbon dioxide content shown by hourly readings. In this way the air change curve shown in Fig. 14 was obtained.

As regards heat losses, the question was somewhat complicated by the fact that the materials of construction in the building varied at different elevations. Further, on account of the height of the room there was a difference in temperature of 40 deg. between the air at the floor level and the peak of the roof. Hence in computing the heat transmission through the wall the temperatures to be used must be those corresponding to that part of the wall in question. For this reason temperatures were taken at various points and the temperature curve (Fig. 15) drawn, this curve being approximately a straight line. The original article gives a detailed calculation of heat losses through the windows in one of the walls in which use is made of this temperature curve.

On the whole it was found that one complete air change required about 56½ min., and results were obtained showing the total heat losses through the floor, roof, edge of the walls and

through the air change, respectively. (*The Heating and Ventilating Magazine*, vol. 15, no. 7, July 1918, pp. 18-24, 9 figs., *e*)

Railroad Engineering

FIRST OF THE U. S. STANDARD LOCOMOTIVES. Description of the first of the standard locomotives, namely, a light Mikado type built by the Baldwin Locomotive Works for service on the Baltimore & Ohio.

There is nothing of an unusual character either in the general design or the details of construction. The boiler is of the conical wagon-top type, 78 in. in diameter over the first course, increasing to 90 in. in outside diameter at the dome course, Fig. 16. The longitudinal seam of the dome course is on the left-hand side of the center line, and the reinforcing pad on the inside of the shell under the dome is extended to form the inside welt strip of this seam. The longitudinal seams of the conical and front courses are at the right and on the top center line of the boiler, respectively. These seams are all welded at the ends.

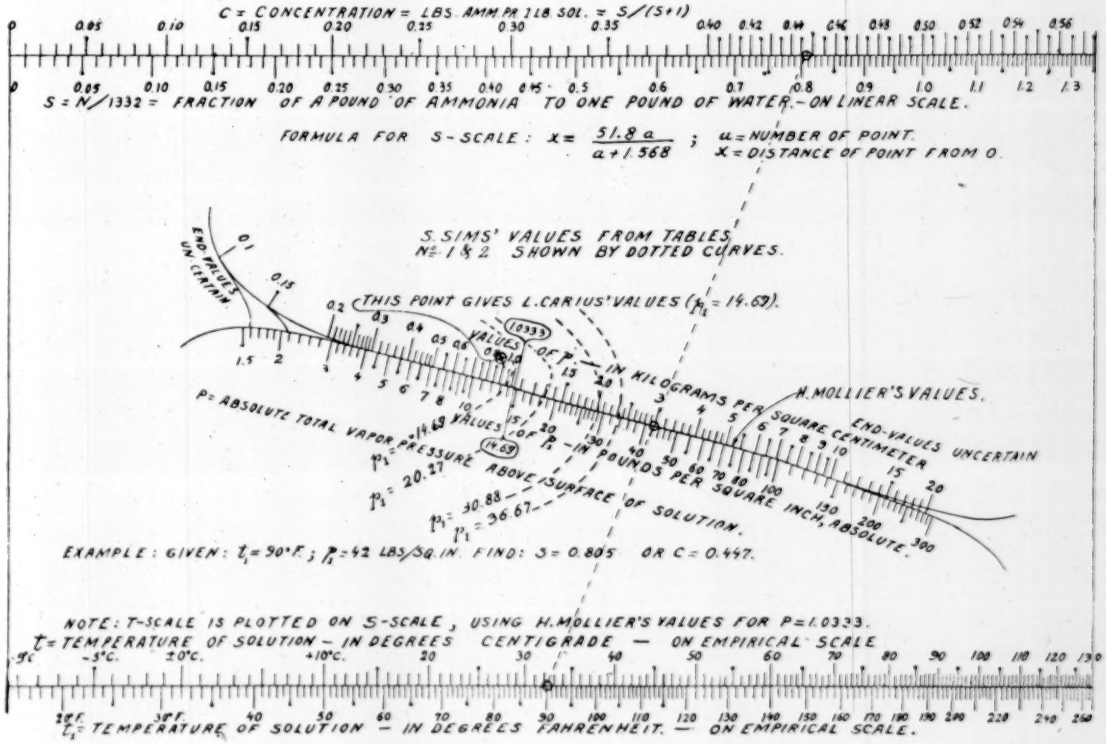

C = CONCENTRATION = LBS. AMM PR / LB SOL. = S/(S+1)
S = N/1332 = FRACTION OF A POUND OF AMMONIA TO ONE POUND OF WATER. — ON LINEAR SCALE.
FORMULA FOR S-SCALE: x = 51.8 a / a+1.568 ; a = NUMBER OF POINT. X = DISTANCE OF POINT FROM 0.
S. SIMS' VALUES FROM TABLES N° 1 & 2 SHOWN BY DOTTED CURVES.
END-VALUES UNCERTAIN
THIS POINT GIVES L. CARIUS' VALUES (p_1 = 14.69).
VALUES OF p_1 — IN KILOGRAMS PER SQUARE CENTIMETER
H. MOLLIER'S VALUES.
P = ABSOLUTE TOTAL VAPOR PRESSURE ABOVE SURFACE OF SOLUTION.
VALUES OF p_1 — IN POUNDS PER SQUARE INCH, ABSOLUTE.
p_1 = 14.69
p_1 = 20.27
p_1 = 30.88
p_1 = 36.67
EXAMPLE: GIVEN: t_1 = 90° F.; p_1 = 42 LBS/SQ. IN. FIND: S = 0.805 OR C = 0.447.
NOTE: T-SCALE IS PLOTTED ON S-SCALE, USING H. MOLLIER'S VALUES FOR P = 1.0333.
t = TEMPERATURE OF SOLUTION — IN DEGREES CENTIGRADE — ON EMPIRICAL SCALE
t_1 = TEMPERATURE OF SOLUTION — IN DEGREES FAHRENHEIT. — ON EMPIRICAL SCALE.

FIG. 13 NOMOGRAM FOR SOLUBILITY OF AMMONIA

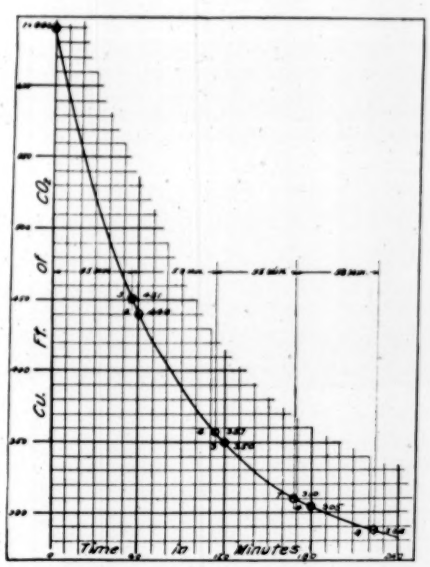


FIG. 14 AIR-CHANGE CURVE

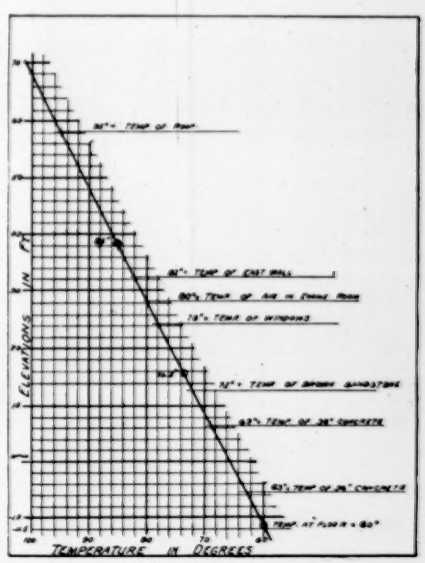


FIG. 15 CURVE FOR DETERMINING TEMPERATURE AT VARIOUS ELEVATIONS IN ENGINE ROOM

On the basis of Cole's ratios, the boiler capacity rating is practically 96 per cent of the cylinder requirements in respect to the heating surfaces, and slightly over 100 per cent in respect to the grate area. The tubes are 2¼ in. in diameter and

19 ft. long over the tube sheet, the ratio of the diameter to the length of tubes being about one to 100. The firebox includes a combustion chamber 24 in. long and is fitted with a Security arch. The boiler includes a 40-unit Schmidt top-header superheater with 5½-in. superheated flues, and is fired by a Duplex stoker. It is fitted with a Shoemaker fire door.

The ashpan has three center hoppers with swinging drop bottoms. The opening under the mud ring is 5½ in. wide. The grates are operated by a Franklin grate shaker. (*Railway Age*, vol. 65, no. 3, July 19, 1918, pp. 131 to 133, 5 figs., *d*)

Refrigeration (See Physical Chemistry)

Steam Engineering (See also Internal-Combustion Engineering)

A NEW THEORY OF THE STEAM TURBINE, Harold Medway Martin. Presentation of a new theory of the steam turbine in which the leading idea is that steam is not in thermal equilibrium where it was hitherto supposed to be.

In the investigation of the performance of steam turbines some notable discrepancies between theory and apparent practice were discovered, one of these being that under certain conditions the weight of steam discharged from a nozzle was actually greater than what was physically possible according to the then accepted theory. At first it was attributed to the moisture in the steam, but this explanation was discarded when it was found that to bring this theory into accord with experiment would involve the presence of anywhere between 10 and 20 per cent of moisture in the steam. Later on this anomaly was attributed to a fundamental error in the then accepted theory of the efflux of steam; namely, that the expansion of wet steam did not proceed under conditions of thermal equilibrium as was previously assumed.

The present theory is based on an assumption claimed to be proved by actual experience with steam turbines; namely, that not only is steam not in thermal equilibrium in the "saturated field" of the Mollier diagram, but it is never in thermal equilibrium until the condenser is attained. The relation between volume and pressure during the expansion of wet steam is accordingly never the same as if thermal equilibrium were established.

In opening a turbine it is easy to see the difference in the appearance of the blading which has been exposed only to superheated steam and that which, on the ordinary theory, has been subjected to the action of wet steam. In the region where the steam was supersaturated a film of moisture is deposited on the blading and it is this very phenomenon that for a long time interfered with the detection of undercooling in steam turbines and steam engines. In any attempt to take the temperature of the steam by means of a thermometer a film of moisture was immediately deposited on the bulb or on the exterior of the thermometer pocket if the steam were supersaturated, and the thermometer recorded the temperature of this film and not that of the surrounding vapor. Hence, for many years it has been noted that the temperature of the steam as indicated by a thermometer placed in a turbine exhaust pipe was sensibly below that corresponding to its pressure. These low readings are all the more remarkable in that experiment has shown that a thermoscope immersed in a current of a permanent gas tends to give too high a reading, owing to adiabatic compression of the fluid against the obstacle.

The writer mentions a possible objection against the idea that there is any large degree of undercooling in the turbine exhaust, viz., the fact that in experiments with nozzles discharging into open air Dr. Stodola showed that once condensation commenced it proceeded with extreme rapidity. However, he calls attention to the fact that the occurrence of condensation or even its completion does not necessarily imply the simultaneous establishment of thermal equilibrium. In fact, there is evidence in favor of the view that there is a sensible lag between the two.

In the experiments of Stodola the droplets observed by him in his jets of undercooled steam were formed in a period of time of the order of one ten-thousandth of a second, while the time occupied by steam in flowing through the low-pressure end of a turbine is some hundred times as great. Were it not for the lag between condensation and thermal equilibrium, it is difficult to see how these droplets could be built up with such rapidity. Each molecule as it condenses liberates energy sufficient to raise its own temperature by some 500 or 600 deg. cent. and were this energy immediately and wholly transformed into heat, it is difficult to see how the temperature of the surface could be kept low enough to permit of the building up by further condensation of droplets observed by Dr. Stodola.

The author also brings forward the following interesting reasoning to prove that the instantaneous conversion into heat of the energy liberated on condensation is unlikely. He claims that the forces responsible for the attraction between the molecules of the same substance to which the phenomenon

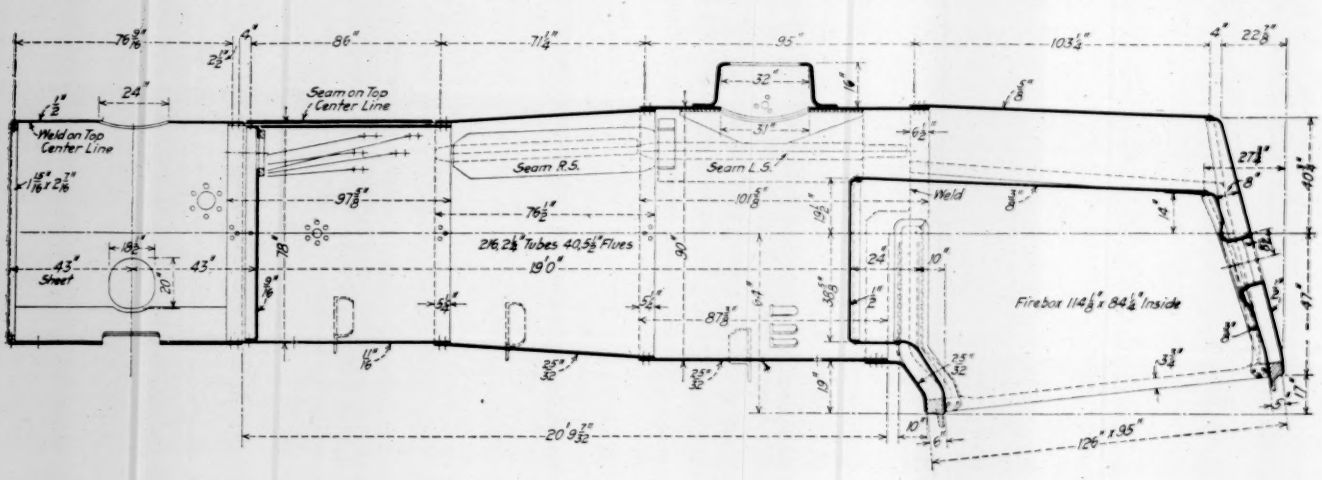


FIG. 16 BOILER OF THE RAILROAD ADMINISTRATION STANDARD LIGHT MIKADO TYPE LOCOMOTIVE

of liquefaction is due, are essentially of the same nature as the forces holding together a chemical compound, i.e., electrical. There are thus good grounds for believing that the energy liberated on the condensation of a vapor is at the outset represented by electrical disturbances and is only somewhat gradually converted into the form of heat. In support of this view the writer cites the paper of Wilson in the *Philosophical Transactions* for 1897, where the latter states that if the expansion of dust-free vapor was just sufficient to produce condensation the number of droplets formed was of the order of 10^7 per cu. cm., but that this number increased very rapidly if the range of expansion was increased. This affords direct proof that the additional condensation took on new nuclei and the temperature of the vapor must accordingly have been far below the equilibrium value during the whole range of expansion. The time taken for the expansion in Wilson's experiments was estimated at something over 1/50 of a second and was thus of the same order as the total time taken for steam to pass completely through a modern steam turbine, the inference being that the steam as finally discharged from such a turbine is used in a greatly undercooled and supersaturated condition.

The author in his present paper attempts to show that if his interpretation of Wilson's results be accepted (*i.e.*, that the expansion continues with the vapor temperature far below that which would be indicated by any thermometer immersed in it) both superheat and vacuum corrections can be rationalized, while a contrary view involves wide discrepancies between theory and practice.

For this purpose the author gives a somewhat modified Callendar steam table (Fig. 17).

Until Professor Callendar took up the matter, the formulæ used to represent the properties of steam were wholly empirical and were very commonly mutually inconsistent. Thus the values deduced for the specific heat of superheated steam from the experiments of Knoblauch and Jakob and adopted as the basis of certain well-known tables are quite inconsistent with the specific volumes of the steam also given in the same tables, the discrepancy being as much as 20 per cent. Callendar's formulæ have, on the other hand, been deduced from considerations of the physical nature of steam and the known laws of thermodynamics. Their form has been fixed by theoretical considerations, and the coefficients only determined by experiment. All the formulæ are mutually consistent with each other and agree with the only reliable experimental data so far available. In preparing the chart Callendar's formula for the isentropic expansion of steam was employed, viz.:

$$p^{-2/13}\,T = \text{constant}$$

where p denotes the absolute pressure of the steam and T the absolute temperature. Starting with high-pressure steam at a given entropy, the absolute temperature attained on expansion to a lower pressure was then determined by Callendar's equation for the total heat of steam, which in pound-centrigrade units is:

$$H = 0.47719\,T + 464 - \frac{144}{1400}\cdot p\left(\frac{13}{3}\times 0.4213\left(\frac{373.1}{T}\right)^{10/3} - 0.01602\right)$$

At least seven points were calculated for each curve represented on the diagram. The computations were made with five-figure logarithms and checked by examining the differences. This test led to the detection of a few small isolated errors, which were duly corrected. The calculation was made to five figures and the plot to four figures.

One innovation which is thought to be of importance is that the abscissæ values are not values of the total heat H but of $2.2436\,(H - 464)$. As a result, specific volumes can be obtained from the diagram with great accuracy.

It is merely necessary to divide the abscissa reading by the pressure, and to add the constant 0.0123. For example, the abscissa reading corresponding to 90 lb. and 240 deg. cent. is 536.65. Hence the specific volume is:

$$(536.65 \div 90) + 0.0123 = 5.962 + 0.012 = 5.974$$

The value given in Callendar's tables is 5.9741.

The adiabatic heat drop is measured in the same way as with the ordinary Mollier diagram. The Wilson line shown in the diagram represents the limit to which steam originally dry or superheated can expand without condensation occurring. The method used in deriving it will be set forth in a later issue, to which also will be deferred a description of the two diagrams of reheat factors.

Full lines on the diagram refer to superheated or supersaturated steam. Dotted lines and heavy figures refer to wet steam in a state of thermal equilibrium, a state which is never attained when wet steam expands inside a turbine or an engine cylinder.

Pressures are absolute, and temperatures in centigrade degrees. The entropy is constant along horizontal lines, and the total heat is constant along vertical lines. The numbers affixed to these verticals are, however, not values of H but values of $2.2436\,(H - 464)$.

Heat Drop. To find the isentropic heat drop, mark on the diagram the initial state point of the steam, and from this point draw a horizontal to the final pressure line. The length of this line measured on the scale provided is equal to the heat drop. There are two scales, one of which gives the heat drop in B.t.u. and the other in pound-centigrade units.

Specific Volumes. To find the specific volume of superheated steam, note the value of the abscissa corresponding to this state point. Divide this value by the absolute pressure of the steam and add 0.0123. To find the specific volume of wet steam in thermal equilibrium multiply the volume at saturation by the dryness fraction, which is represented on the chart by the dotted curves.

The Wilson Line. Save for the deposit of a thin film of moisture on adjacent surfaces, no condensation occurs when the saturation line is crossed during the expansion of steam (J. Aitken, 1880). The steam merely becomes supersaturated and continues in this condition until by further expansion the Wilson line is reached. Up to this limit the law of expansion and the relation between volume, temperature and pressure is exactly the same as for superheated steam. The Wilson line on the diagram has been plotted from the equation: $\log_{10} p - \log_{10} p_s = 3{:}76\,\sigma/T$, where p denotes the pressure of the steam and T its actual temperature; σ is the surface tension of water at this temperature, while p denotes the saturation pressure at T deg. absolute. The end portions of this curve have been extrapolated.

Reheat Factor. In multistage turbines the effective thermodynamic head is not the isentropic heat drop u, but is equal to u, multiplied by the reheat factor, R, which varies with the range of expansion, and with the hydraulic efficiency of the turbine. The less the efficiency the greater is the reheat factor. The useful work done in a multistage turbine having a hydraulic efficiency η_i is equal to $\eta_i R u$.

To find the specific volume of steam after expansion from p_1 to p_2 in a multistage turbine of hydraulic efficiency η_i, determine the heat drop u', using the full-line curves of the

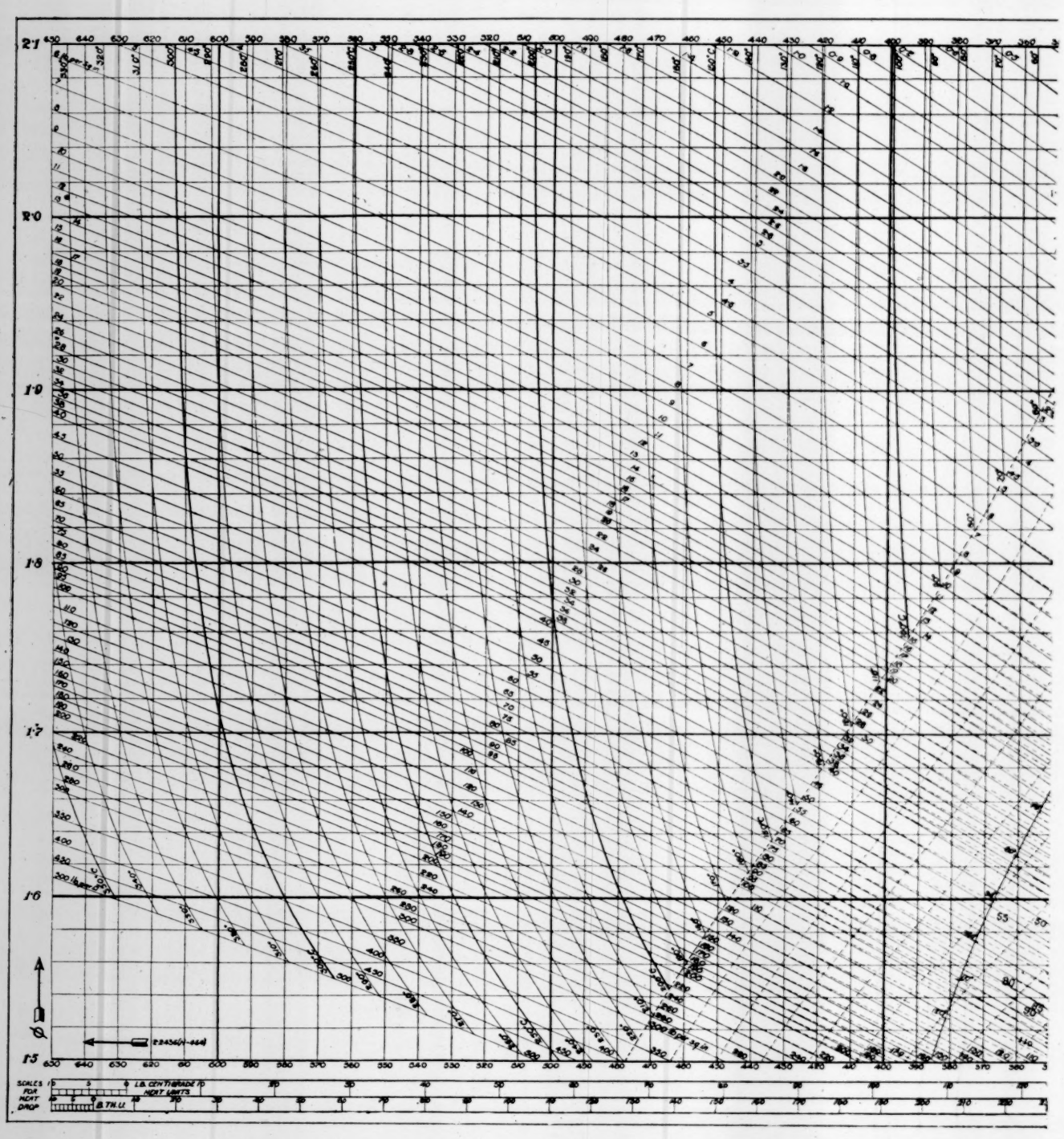
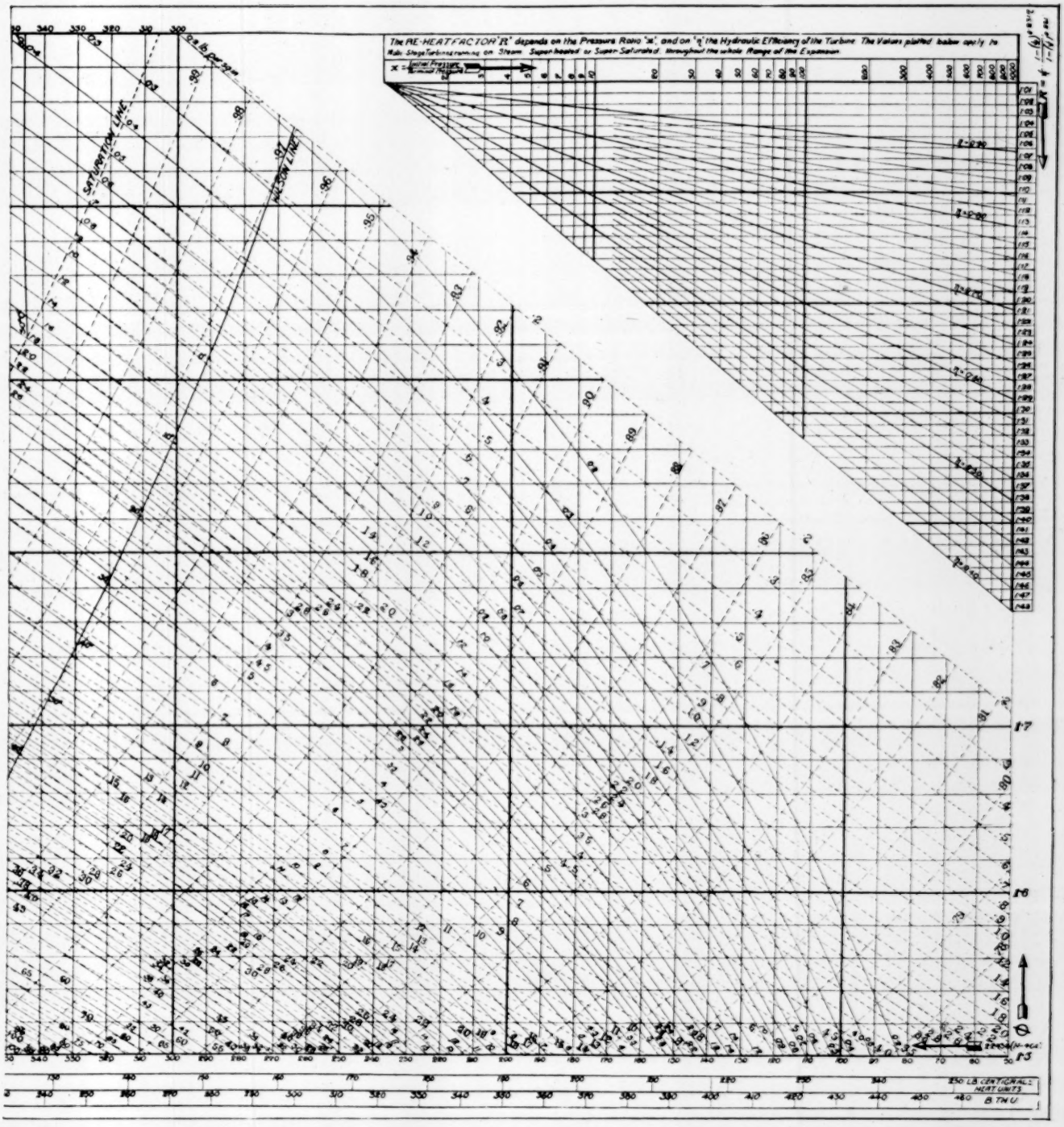


FIG. 17 HAROLD MEDWAY MARTIN'S STEAM CHART

chart; next take out the reheat factor corresponding to η and to $x = p_1/p_2$. Set off horizontally from the initial-state point a distance equal to Ru^1 as measured on the heat-drop scale. From the point thus found, raise a perpendicular to cut the (full-line) curve corresponding to p_2. This intersection represents the state point of the steam after its expansion, accurately if it lies to the left of the Wilson line and roughly in the contrary case. The volume V^1 corresponding to this state point is given by Equation [2].

If the expansion be stopped at the Wilson line approximate thermal equilibrium is rapidly attained and the final state point of the steam can be found by drawing a vertical from the Wilson-state point to cut the dotted line for steam at the same pressure. If the expansion be continued past the Wilson line fresh condensation occurs, but on new nuclei. The temperature during this further expansion remains therefore far below the equilibrium value and the specific volume of the steam and the work done by it are much below the values corresponding to the expansion of wet steam in thermal equilibrium.

From the superheat correction it appears that the specific volume V_w during this stage of the expansion is given approximately by the relation $V_w = 0.8V^1 - 0.2V_s$, where V^1 represents the volume calculated as above and V_s the corresponding volume and the expansion beyond the Wilson line been effected in thermal equilibrium. The value of V_s for


The RE-HEAT FACTOR 'R' depends on the Pressure Ratio 'x', and on 'η' the Hydraulic Efficiency of the Turbine. The Values plotted below apply to Multi-Stage Turbines running on Steam Superheated or Super-Saturated throughout the whole Range of the Expansion
SATURATION LINE
WILSON LINE
150 LB. CENTIGRADE HEAT UNITS
B.TH.U.

BASED ON CALLENDAR'S TABLES AND FORMULÆ

different hydraulic efficiencies can be found by using reheat factors taken from the dotted lines in the annexed factors.

Since the steam in expanding beyond the Wilson line is in a "dynamic" condition, it is probable that these curves of equivalent reheat factors should be bands rather than lines.

1 kilowatt-hour = 1895.5 ft-lb. centigrade units (F. P. C.)
= 3411.9 B.t.u.

1 horsepower hour = 1414.3 ft-lb. centigrade units
= 2545.6 B.t.u.

Theoretical velocity of efflux = $300.2 \sqrt{u}$ (F. P. C.)
= $223.8 \sqrt{u}$ (B.t.u.)

(First of a series of articles: *Engineering*, vol. 106, no. 2740, July 5, 1918, pp. 1-3, and a 2-page plate, *t.1*)

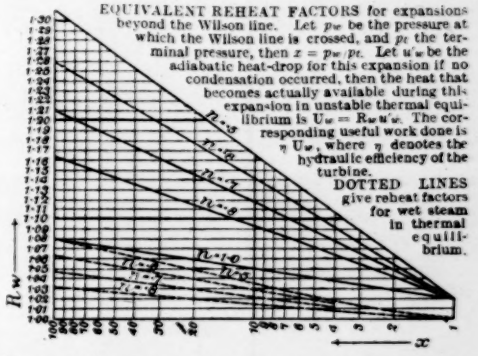

EQUIVALENT REHEAT FACTORS for expansions beyond the Wilson line. Let p_w be the pressure at which the Wilson line is crossed, and p_t the terminal pressure, then $x = p_w/p_t$. Let u'_w be the adiabatic heat-drop for this expansion if no condensation occurred, then the heat that becomes actually available during this expansion in unstable thermal equilibrium is $U_w = R_w u'_w$. The corresponding useful work done is ηU_w, where η denotes the hydraulic efficiency of the turbine.
DOTTED LINES give reheat factors for wet steam in thermal equilibrium.
R_w
x

FIG. 18. EQUIVALENT REHEAT FACTORS FOR EXPANSIONS BEYOND THE WILSON LINE

Testing

TESTING OF ALUMINUM SHEETS, Robert J. Anderson. In a previous article (THE JOURNAL, June 1918, p. 506) an account was given of Erichsen tests made on annealed 18-gage aluminum sheets and it was shown how the effects would become apparent earlier on cold-rolled aluminum sheets with increasing percentages of reduction. In the present article the writer discusses the use of exceedingly short time exposures at various temperatures.

It is claimed that more prolonged exposure results in over-annealing, which latter produces a weakened condition of the metal and makes it unfit for drawing.

In order to demonstrate roughly how much time is required for annealing, a number of samples of cold-rolled 14-gage aluminum sheets reduced 72 per cent were exposed for two hours at 400 deg. cent. Forty blanks so annealed were drawn

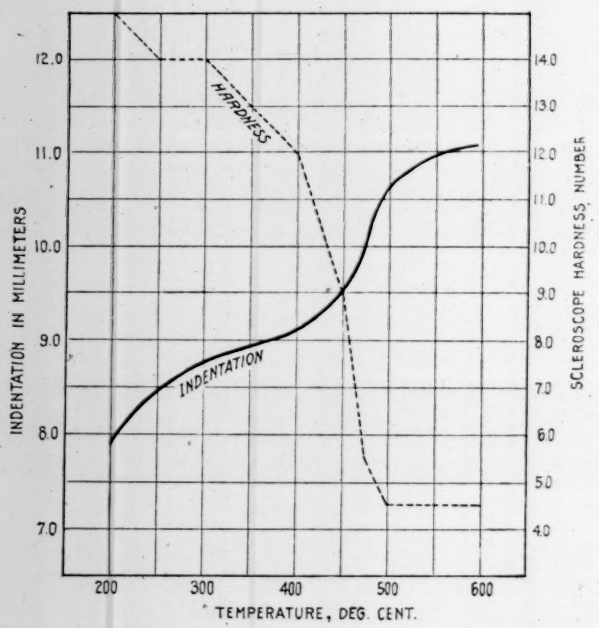


FIG. 19 TEMPERATURE-INDENTATION AND TEMPERATURE-HARDNESS CURVES FOR 14-GAGE ALUMINUM SHEETS EXPOSED FOR 3 MIN.

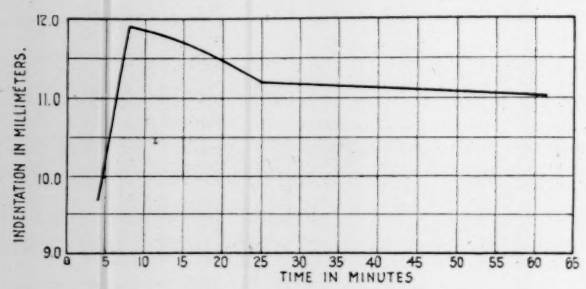


FIG. 20 TIME-INDENTATION CURVE FOR 14-GAGE ALUMINUM SHEETS AT 450 DEG. CENT.

in the draw press and all of them successfully withstood the draw.

Then some annealing experiments were performed with the view to softening the 14-gage cold-rolled sheets by means of relatively short exposures at various temperatures. These annealing experiments were performed in a laboratory electric furnace of the resistance type and the temperatures given are accurate within ± 10 deg. cent. The time of exposure was 3 min. Fig. 19 gives the temperature-indentation and temperature-hardness curves for these tests and shows that the scleroscopic hardness falls off rapidly with increasing temperature and the indentation increases gradually to a maximum attained at the exposure at the highest temperature employed.

The preliminary short-time annealing experiments showed that 14-gage cold-rolled aluminum sheets could be softened at 4-5 Shore scleroscope hardness numbers by 3-min. exposures at temperatures of 500 deg. cent. and above. In the next series of tests 80 cold-rolled blanks with accompanying smaller samples for test purposes were annealed at constant temperature and variable time, as shown in Fig. 20. It was found that softening, so far as required by practice, can be effected for cold-rolled 14-gage aluminum sheets by an exposure of as little as 8 min. at 450 deg. cent.

The writer called attention to the fact that the deepest indentation value secured by the annealing tests was for sample 13, which had been exposed for 8 min. With longer exposures at the same temperatures the indentations are less deep, a fact which accords very well with the time-indentation curve of Fig. 20. (*The Iron Age*, vol. 102, no. 3, July 18, 1918, pp. 148-149, 2 figs., *e*)

Varia

THE RISING COST OF MACHINE BUILDING, Ludwig W. Schmidt. The writer discusses the rising cost of the elements entering into machine construction, such as labor, material and what he summarizes under the name of factory costs. A chart is given showing the variation in the margin of profit, cost of materials and cost of labor during the year 1917, which reveals a reduction in the margin of profit of noticeable magnitude.

The writer comes to the conclusion that doubt exists whether under present conditions a machine manufacturer acts wisely to cut his profit margin too narrow, and it is questionable whether even 30 per cent of the factory sales price can be called a safe margin. (*American Machinist*, vol. 49, no. 5, August 1, 1918, pp. 209-211, 1 fig., *g*)

ON THE CRITICAL ABSORPTION AND CHARACTERISTIC EMISSION X-RAY FREQUENCIES, W. Duane and Kang-Fuh Hu. Results of an experimental measurement of the critical absorption wave-length (λ_a) and the wave-length ($\lambda\,\gamma$) of the γ line in the emission spectrum by means of a Coolidge X-ray tube with a rhodium target, the current through it coming from a high-potential storage battery. From a paper presented before the American Physical Society. (*Physical Review*, vol. 11, no. 6, June 1918, pp. 489-491)

THE RELATION BETWEEN THE GENERAL X-RADIATION AND THE ATOMIC NUMBER OF THE TARGET, W. Duane and T. Shimizu. Investigation of the general X-radiation from the four elements iron (26), cobalt (27), nickel (28) and copper (29), to decide whether or not its intensity increases with the atomic number of the elements. Abstract of a paper presented before the American Physical Society. (*Physical Review*, vol. 11, no. 6, June 1918, pp. 491-492)

CLASSIFICATION OF ARTICLES

Articles appearing in the Survey are classified as *c* comparative; *d* descriptive; *e* experimental; *g* general; *h* historical; *m* mathematical; *p* practical; *s* statistical; *t* theoretical. Articles of especial merit are rated *A* by the reviewer. Opinions expressed are those of the reviewer, not of the Society. The Editor will be pleased to receive inquiries for further information in connection with articles reported in the Survey.

CORRESPONDENCE

CONTRIBUTIONS to the Correspondence Departments of The Journal by members of The American Society of Mechanical Engineers are solicited by the Publication Committee. Contributions particularly welcomed are suggestions on Society Affairs, discussions of papers published in The Journal, or brief articles of current interest to mechanical engineers.

Fuel Conservation in the Petroleum Industry

TO THE EDITOR:

In few industrial fields is there a greater lack of engineering talent, coupled with a more favorable opportunity for engineers, than exists in the petroleum industry.

The drilling and pumping methods in the production of petroleum are substantially the same as they were forty years ago, and in the refineries the vast majority of distilling apparatus is identical in type with that of the earliest development, and, most significant of all, nearly all patents on distilling processes and apparatus have been granted to other than technical men.

Necessity, the mother of invention, has developed for both the driller and the refiner equipment that performs, in a measure, satisfactorily, even if inefficiently; therefore the efforts to increase efficiency have received no impetus except through the stimulating effect of large profits, and such efforts have been in the direction of increasing the production in the field and the yield in the refinery, rather than in attempting to secure increased revenue through operating refinements.

The subject of heat transfer receives little attention, the fuel used being considered merely a means to an end, yet the success of the numerous "cracking" processes hinges largely on this very question.

In the Rittman process, tubes with excessive wall thicknesses are employed to enable the use of the desired internal pressures at the temperatures necessary for "cracking," and flame temperatures, under forced draft, are allowed to impinge on a relatively small portion of the heating area.

In the Burton and other cracking processes, horizontally inclined tubes are subject to temperatures causing inevitable sagging and, only too often, rupture.

In the ordinary fire still, the desired temperatures are attained at a fuel and still-bottom-maintenance cost out of all proportion to the results obtained, and the derived vapors are condensed and the residuum cooled, at an additional expense of energy for pumping water.

The production of steam accounts for the use of nearly 50 per cent of the total fuel used in refineries, yet in the selection, installation and operation of boilers and auxiliaries little attention is paid to economy or efficiency. Feedwater temperatures in excess of 140 deg. fahr. are the exception, even with exhaust steam wasting to the atmosphere; flue-gas temperatures above 1000 deg. are common, and below 750 deg. very rare.

About fifty per cent of the steam generated is for use in the sills, the rest being used for pumping, etc. As the duty for steam in the stills is merely that of a medium for heat transfer, the exhaust from the pumps, engines, etc., is practically as valuable as live steam, but this fact is in many refineries unknown or ignored.

By the use of steam-driven electric generating equipment operating at 20 to 30 lb. back pressure (serving simply as a reducing valve), and the superheating of the exhaust steam for use in the stills, it is safe to say that 35 to 40 per cent of the present boiler fuel can be saved, and that the investment will pay for itself in twelve months in the average refinery.

In the Mid-Continent field the type of boiler commonly used is the portable locomotive-firebox boiler. Being simply a means to an end, no consideration is given it other than its portability, cost and steaming capacity, the latter requirement being according to the actual drilling need; when pulling tools and cleaning, the boiler is only half large enough, the firebox area being too small for high ratings. At these periods much time is wasted "waiting for steam."

In an article which I recently contributed to the *Doherty News* (April, 1918), it was stated that a series of tests run on both natural-gas and crude-oil fuels under 35-hp. locomotive-firebox boilers showed the average drilling boiler used 90,000 cu. ft. of gas a day or 16 bbl. of crude oil. These tests, with

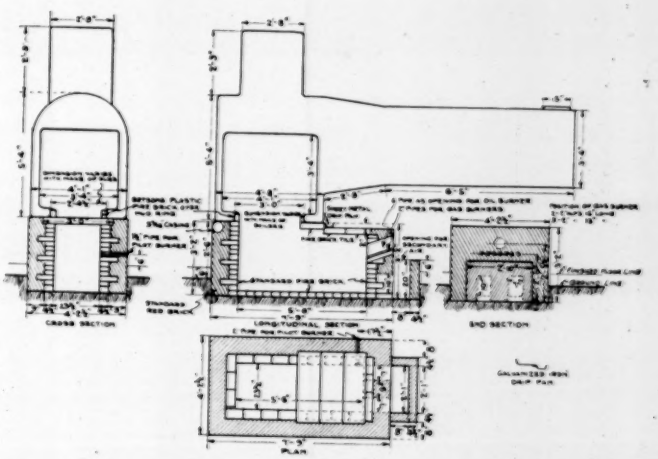


FIG. 1 BRICK SUB-FURNACE USED WITH LOCOMOTIVE-FIREBOX BOILER

others, coupled with various experiments, have led to the development of methods and equipment which today are effecting savings in fuel consumption amounting roughly to 25 per cent.

The most notable development is that of the brick sub-furnace shown in Fig. 1, which not only effects the savings shown in Table 1, but also allows double rating of the boiler when necessary.

The boiler covering consists of No 28 gage $\frac{3}{8}$-in. "hy-rib" fitted around the boiler and securely wired on. To this is applied $\frac{3}{8}$ in. of 85 per cent magnesia, which is then coated with $\frac{1}{8}$ in. of waterproof dressing such as the combination of asbestos, gilsonite, asphaltum, etc. This covering costs about 30 cents per sq. ft., and is not only weatherproof, but will with reasonable care stand moving many times.

The portable boiler-cleaning outfit consists of a gasoline-engine-driven air compressor mounted on a suitable truck with a boiler-tube "air-hammer" scale remover, and with two experienced operators will effectually clean a boiler of all scale adhering to the tubes in two to three hours.

The price of crude oil is fixed by the pipe-line companies and is based on the average known specific gravity of oil pro-

TABLE 1 SAVINGS POSSIBLE IN OIL-FIELD BOILER OPERATION

Nature of Improvement	Installation cost per boiler	Saving per boiler per year of 365 days	
		Gas fuel	Oil fuel
Boiler Covering:			
Inside boilers	$50	$192	$480
Outside boilers	50	470	1175
Sub-Furnaces complete with Gas and Oil Burners:			
Steaming-plant boilers	60	900	2550
Drilling boilers	60	1150	3000
Feedwater Heater and Piping:			
For 4 boilers	175	275	780
For 8 boilers	125	275	780
Boiler-Cleaning Equipment with Air Compressor:			
Steaming-plant boilers	25	400	750
Drilling boilers	25	275	600

duced. Weathering and dehydration methods are responsible for the loss of 3 to 11 per cent of the total production (actual test data), yet the pipe-line companies place no restrictions upon the producer tending to discourage practices responsible for these wastes. As a matter of fact, they encourage the waste by refusing to run oil containing greater than a given percentage of water, knowing as they must that the removal of this water is almost invariably attended with considerable losses of the more volatile, and therefore more valuable, hydrocarbons.

Many of the larger producers control their own pipe lines and refineries. One of these used in the past twelve months for fuel in the fields over 300,000 bbl. of crude oil worth, at the market price, over $600,000. Forty per cent of this was entirely too valuable for use as fuel. A $100,000 topping plant would have saved this, and the investment would have paid out in a year at the outside.

I am speaking only of the operations I have witnessed in the Mid-Continent fields, but because of the investment involved they are doubtless typical.

A careful review of the professional cards appearing in the periodicals devoted to the oil industry shows that the mechanical engineering profession is very inadequately represented as compared with the geologists, mining engineers and chemists.

The U. S. Bureau of Mines is probably doing more constructive work in the petroleum industry than any other body, but there is an immense amount of work of the most valuable character awaiting the engineer in this field.

W. G. WILLIAMS.

Bartlesville, Okla.

Crippled Employees Are Able to Make Good

TO THE EDITOR:

Contrary to the general rule, our plant was in favor of older men, and had for a number of years hired the man of mature years in preference to the youth, other things being equal. We had found them steadier and to require less supervision: three-fourths of our work was manufacturing of an exact nature where these qualities counted more than semi-frequent bursts of speed. Located in a manufacturing center where piece work was general except in machine shops, it was hard to get and retain all the able-bodied men we needed, so almost unconsciously we formed the habit of arranging working operations to accommodate the infirmities of the men who generally find it difficult to obtain employment and who appreciate efforts made to enable them to earn a living, apply themselves, work steadily, and stick.

A few instances will show how we got along, and may suggest ideas for greater development in the same field. A visitor, a superintendent from a distant machine shop, was going through the plant one day, and remarked, "Where did you get all the cripples?" A year later, when the draft had cut deep into his ranks and the inducements of profiteers still deeper, he doubtless would have been glad to obtain the services of many of those cripples who had become valued employees by that time.

Several men who applied were ruptured and could not do lifting and were put to work on milling machines and punch presses. At this light labor they were perfectly safe and content. One man had lost all but the stump of a foot in a railroad accident and had worked in factory after factory, always, however, having to quit because he could not bear his weight all day on the injured foot; but on a power press he could work in comfort, and he turned out a large amount of work. This same man had picked up considerable knowledge in the operation of automatic machinery in various factories, and when a vacancy occurred he was put on a battery of screw machines; in a month's time he could set any of the automatics in the shop, and did so well that he kept five going and still found time to sit and rest the lame foot all it needed.

Another of these piece workers—a middle-aged man of known integrity and no little manual skill—had been in the shop but a short time when he asked to be allowed to bid on the "spring job"—a job of "setting" small leaf springs to a gage, an operation that kept two and three busy all the time and that could not be done accurately enough by machine. He argued that he could do the work at home, could save the hour night and morning that he spent on the way, and could work an hour or two at night. At first we didn't altogether like the idea, but after he had tried out a number and quoted us a price that would double his wages and lower our cost nearly a half, we gave in, and he has relieved us of a really troublesome job.

A telegrapher, a hunchback, who had tired of being shunted to lonely stations because of his appearance, applied for work. We had plenty of small assembling and to this his nimble fingers were fitted by long training; the work was as physically easy as his own trade and paid as much—but what was to the point, he was settled and lived at home. One of our younger men, a good lathe hand but always restless, stole a ride on a freight train on a Saturday night and came back three months later minus a foot and with a desire to settle down if we could "give him a job at something," which we did by rigging up a seat and transferring him to one of the small lathes, where he has become a genuine standby. A lad with a withered hand and a desire to work made good on a sensitive drill which was fitted up with a foot feeding attachment.

Other physical defects such as poor eyesight, susceptibility to heat and cold and dust, etc., etc., were encountered, and, if found genuine, an effort was made to supply the possessor with work that he could do in comfort. One deaf and dumb person and one who had an impediment that practically deprived him of speech were carefully instructed and in time became very speedy, reliable workmen.

The instruction of crippled men is one of the things we will undoubtedly be called upon to do in the not distant future, and the foregoing examples may serve to show what can be accomplished with a little patience and exercise of thought.

DONALD A. HAMPSON.

Middletown, N. Y.

SOCIETY AFFAIRS

A Record of the Current Activities of the Society, Its Members, Council, Committees, Sections and Student Branches; and an Account of Professional Affairs of Interest to the Membership

THESE monthly letters which the Secretary has had the privilege of writing to the membership have endeavored to bring out the decided change of thought on the part of engineers as to their obligations on the one hand and the objects and aims of professional societies on the other. Our Society has felt that we were peculiarly sensitive to these thoughts and ambitions of members, particularly those who live at a distance from headquarters, and through its Sections movement and through visits of its officers has tried to keep in touch with them. The American Society of Civil Engineers, similarly recognizing the necessity for "stock taking," has called for a conference at its annual meeting in January to consider whether or not the aims and objects of that society should be restated. As this is such an excellent suggestion, our Sections Committee has actively taken up the matter of a similar conference for the purpose of carrying out its undeveloped plans, and the President has requested Mr. L. C. Marburg of the Committee to secure preliminary suggestions.

All those interested in making the Society useful in every sense, not only to the engineer himself in the advancement of his work, but to the municipality and state in which he lives and to the nation as a whole, are invited to correspond with Mr. Marburg, in care of the Society, and at a conference to be called the latter part of October in Indianapolis and again during the Annual Meeting all suggestions will be most gratefully received. Here, therefore, is an opportunity not only for suggestions of a specific character pertaining to the proper and higher aim of the Society in its work, but for any other suggestions which a member has for the improvement of any phase of that work. The conscientious devotion of the officers of the Society can best be rewarded by the interested participation of every member in a truly democratic manner in the government and guidance of the Society in all of its activities.

Technical Men and the War

The Society very early appreciated the necessity of conserving the technically trained men, including the students in the technical schools. Officers of the Society felt this so deeply that they encouraged the authorities in Washington that it would be consistent with democracy to assign trained men according to the service for which they are best fitted, and, although considerable damage had been done before action was taken, were finally successful in staying the waste of irreplaceable material, essential not only in the firing line and in the military preparations back of the line for officers, but in the industries where many times the number of men are required as are in the actual military establishment.

Consequently this Society is to be congratulated upon its success in calling the attention of the Nation to this, and securing action on what it considered was a prime requisite. The recognition of the Administration of this necessity is now complete and it has developed an important department, namely, that of education and special training, with Dr. Maclaurin at the head of all college training and Mr. C. R. Dooley at the head of special training. The indications are that all of the educational institutions of the United States in which there are over 100 pupils will come under the direction of the War Department.

It must be recognized that the problems of the draft have been complex in the extreme, and it is the duty of every individual to credit those responsible with the same devotion to ideals as oneself.

Training of Women

Our nominee for President, Dean Mortimer E. Cooley, similarly emphasized the necessity of training women for technical pursuits at a meeting of our Detroit Section with the Detroit Engineering Society, this spring. The departments of health and several of the leading educational institutions have also emphasized the opportunities for women, but in chemistry especially, as well as in public health, there is a wonderful field for women. It really becomes a patriotic duty for parents to make sacrifices to give their daughters a technical education.

In the Service

In a brochure entitled In the Service which the members will shortly receive will be stated the degree to which the engineers, as a profession, have taken up active work in the war. The medical profession, all of whom are registered and for that reason are capable of more definite analysis, is reputed to have about 24,000 men in the service, or about 25 per cent. It is no reflection upon our medical friends to state that the engineering profession, both relatively and absolutely, has a much greater percentage.

Permanent Camp for Engineers

All engineers will naturally follow with interest the development of Camp Humphreys, at Belvoir, Virginia, about twenty miles south of Washington and just below the town of Acotink. The Camp embraces the large Fairfax tract adjacent to Mount Vernon and to Gunston Hall, the former plantation home of George Mason, the author of the Bill of Rights. Camp Humphreys has been designated by the War Department as a permanent engineers' camp of the United States and by the first of August it was expected to have about 17,000 men there; later this number will be increased to about 30,000. Officers of the Camp have called at the Society's rooms, and there may later be a proposal to the members of the engineering societies to participate in some form of headquarters for the officers of this permanent engineering camp. In the act of Congress creating the camp and its equipment, no provision for such a building is made, so this building, essential to the welfare of the Camp from a human point of view, will have to be provided through the interest and generosity of the members of the engineering profession.

Calvin W. Rice,
Secretary.

PROGRESS OF THE SOCIETY'S TECHNICAL COMMITTEES

ONE of the fundamental objects of the Society as outlined in the Constitution is to undertake specific investigations in the field of research through the appointment of committees for this purpose. Below are given a few brief notes on the work which has been done by some of our committees during the past year.

A word of appreciation is due all the members of these committees because their work is a labor which they have undertaken for the honor and advancement of the engineering profession, and it often means to them a considerable loss of time which might be devoted to more personal aims, in addition to a financial outlay to cover traveling expenses.

Joint Conference Committee on American Engineering Standards. Due to war conditions, standardization has been brought to the front line of attention, but the final arrangements of the Joint Committee representing the most prominent engineering societies have not yet been completed. Major Barba, one of the representatives of this Society, having accepted a commission in the United States Army, Mr. Henry H. Vaughan, Vice-President of the Dominion Bridge Co., Ltd., Montreal, Canada, and President, this year, of the Canadian Institute of Engineers (formerly the Canadian Society of Civil Engineers), has accepted appointment as the third representative of the Society on this Joint Committee. The other two representatives of the Society on this Committee are Mr. Henry Hess and Mr. Wm. F. Kiesel, Jr.

By means of this Joint Committee it is expected that the activities in standardization of all engineering societies will be coördinated so as to proceed with coöperated effort for progress in the engineering profession. It is also expected that it will provide a means of coöperating with the various bureaus of the Government through its Bureau of Standards.

This Committee, it is expected, will also be the advisory body in the conduct of international standardization activities. This branch of the work, during the war, has shown a need of special attention and will be one of the activities of the Committee when they start work in the near future.

Government Commission to Standardize Screw Threads. In the May JOURNAL announcement was made that a bill was before the Congress to standardize screw threads. This bill is now a law, and it provides that this Society and the Society of Automotive Engineers are to participate in the work. Never before has the United States Government undertaken national standardization to the degree that is specified by this bill.

The Commission will consist of two representatives from The American Society of Mechanical Engineers, two from the Society of Automotive Engineers, one from the Army and one from the Navy, and a representative from the Bureau of Standards. Secretary Redfield has already invited the Society to advise him of its nominations for membership on the Commission, and the matter is now before the Council and announcement will soon be made.

It is expected that the Commission will begin its activities very shortly and that its work will be completed within the time allowed by the bill, which is six months.

Committee on Screw Threads and Threaded Parts. In order to secure coördinated effort in standardization of all parts having screw threads, it has been decided that an inclusive committee should be formed of the several committees of the Society who consider the various branches of screw-thread standardization. Efforts in this direction have been successful and the following members have accepted appointments: E. M. Herr, *Chairman;* E. H. Ehrman, *Vice-Chairman;* Stanley G. Flagg, James Hartness, A. M. Houser, Frank O. Wells.

In general, the duties of this Committee will be advisory, and it will assign work to sub-committees who in turn will formulate details. The members of this Committee will be *ex officio* members of all of the existing committees considering screw-thread standards, and such existing committees automatically become sub-committees of the Screw Threads and Threaded Parts Committee. One of the functions of this Committee will also be to follow the activities of other societies and governments in the work of screw-thread standardization and avoid duplication, and an effort will be made to bring together all interests and obtain results generally acceptable.

Joint Committee for Standardization of Machine Screw Nuts. In this work the Society is coöperating with the American Society of Automotive Engineers. This Joint Committee has prepared a tentative specification which is acceptable to the majority of machine-screw nut manufacturers. On account of the absence of the chairman, who was called by the Government for duty in Europe and was away for a period of two months in the spring, the work of the Committee has been delayed, but they are now proceeding and hope in the near future to present a report.

Committee on Pipe Flanges and Fittings. The American Society of Mechanical Engineers in appointing a committee to consider the standardization of pipe flanges and fittings, recognized the need of an industry affecting in a vital manner almost every other branch of industry in the United States.

In 1914 the Committee on the Standardization of Flanges made a report[1] on flanges from 1 in. to 100 in. in diameter for 125 lb. per sq. in. working pressure, and for flanges and fittings from 1 in. to 48 in. in diameter for a working pressure of 250 lb. per sq. in. The value of this report was immediately recognized and led to a request that the subject be further investigated, with the result that at the Spring Meeting at Worcester Report No. 3 of this Committee was presented. This report, which is in addition to the 1914 Standard, covers standard flanges for pipe from 12 in. to 54 in. in diameter with a working pressure of 50 lb. per sq. in. and flanges and fittings for ½ in. up to 12 in. in diameter for a hydraulic working pressure of 800 lb. per sq. in. and, within the same limiting sizes, for 1200 lb. per sq. in.

The Committee further investigated and has recommended standards for hydraulic pressure of 3,000 lb. per sq. in. for flanges and fittings varying in sizes for pipe from ½ in. in diameter up to 12 in. in diameter. This report will be published in an early issue of THE JOURNAL, as well as in pamphlet form.[2]

Committee on Limits and Tolerances in Screw Thread Fits. In the August issue of THE JOURNAL a valuable progress report of this Committee was published which it is believed has been greatly appreciated by the engineering profession. This Committee is still energetically pursuing its deliberations and is now working on formulæ for tolerances for refined, medium and rough work, and will doubtless in the near future have a still more valuable report to make.

Gage Committee. Gages are one of the things which vitally affect production, as without them the manufactured goods would not conform within the prescribed limits and the final production would fall behind the requirements. This is the condition which confronted the Ordnance, Quartermaster and

[1] Paper No. 1430, Trans.Am.Soc.M.E., vol. 36, pp. 29-57.

[2] For previous reports on flange standardization, see Papers Nos. 481, 504 and 826.

Signal Corps Departments of the United States Army, and the Engineering Division of the United States Navy, and led to the formation of a committee. It was formerly the custom—and to our regret it is still continued to a certain extent—to have various authorities for the certification of gages. This Committee recommended that there be but one place to certify gages and that these master gages be located in one or more of the important industrial centers. This recommendation has been quite generally accepted and the U. S. Bureau of Standards has been agreed upon by the several bureaus as such a place. Its practice is to certify to master gages. As announced in a previous issue of THE JOURNAL, this plan was accepted by several of the bureaus of the United States Government and has already been of great benefit in assisting in the production of munitions and all other engineering requirements for the auxiliary branches of the Army and Navy services. Our Committee, in general, has been of an advisory character and the members have traveled at their own expense to Washington and to a number of munition- and ordnance-producing centers of the United States.

War Industries Readjustment Committee. This Committee, as the name indicates, is another of those committees produced by the war and since its creation, in June this year, has been in correspondence with manufacturers and organizations in a position to render technical service of various kinds. It has brought together engineers and manufacturers and furnished names of concerns able to render technical services or to manufacture articles as sub-contractors. It has notified the regional representatives, and in many cases the War Industries Board, of the offers of services and plants. It has also directed these offers of services and plants to the War Industries Board in the various regions. The Committee is doing everything possible to effectively assist the War Industries Board.

Tin Conservation (Bearing Metals Committee). Our Bearing Metals Committee, with the approval of the President, have increased the scope of their work so as to include the consideration of Conservation of Tin, and to coöperate with the Tin Section of the War Industries Board, Washington. It is not generally known that one of the most serious shortages at this time is that of tin. In the transportation of food to our troops in Europe, tin coating of the container where in contact with the food is absolutely necessary, and the war has produced such a tremendous shortage of this metal that tin conservation is perhaps just as important as fuel, wheat and sugar conservation. Tin has been used extensively in connection with bearing-metal alloys and when the question of its conservation was brought to the attention of our Committee on Bearing Metals, they immediately accepted the work of making a careful study of the matter. Bearing metals may be made with a much reduced percentage of tin, but in the case of food containers it cannot be reduced without endangering the quality of the food.

Our Committee is now carefully considering this problem of finding substitutes for tin and the Society awaits with interest the result of their deliberations. Mr. T. G. Cranwell, Assistant to Chief in Charge of Tin, War Industries Board, Washington, D. C., and president of the Consolidated Can Co., is directly handling this work and a letter has been received from him recommending that all our members and other engineers and people who have the interests of the United States and its Allies at heart use tin with extreme care and if possible do without it, so that the necessary requirements of the Government may be met.

Power Test Code. The necessity of there being a standard code for the measurement of all power and a standard method by which such measurements will be taken has long been a recognized necessity. Our Committee was formed with the object of satisfying that requirement and it is expected to offer a progress report in the very near future. The members of the Society will await with interest news of their report.

Refrigeration Committee. This Committee has been in existence for some time and is coöperating with other interested societies.

Boiler Code Committee. The Boiler Code Committee has during the early half of the year been active in pursuing its research and investigations in connection with the work of revising the Boiler Code which was begun early in 1917. At the same time, the Committee has continued the regular monthly meetings at which interpretations have been formulated for all cases presented to it for consideration, a total, up to the present time, of 199 cases having been brought before the Committee for formal action. At the present time, the revision work on the Code can be said to be practically completed, with the expectation that the new Edition of 1918 will be published in September. Also the new locomotive-boiler section of the Code has now been placed in definite form by the Locomotive Sub-Committee, and will receive the consideration of the Committee early in the fall. The Committee is also actively at work on the proposed boiler-inspection rules.

Committee on Steel Roller Chains. This is a Joint Committee with the Society of Automotive Engineers.

Proposed Committee for the Standardization of Shafting. This proposed Committee is an outgrowth of our Committee on War Readjustment and is in process of formation. Several engineers have advised us that steel shafting manufactured only in sixteenth sizes, and with the odd sizes eliminated, would save a considerable amount of material each year.

Committee on Small Hose Couplings. This is a new Committee which is being formed and which has been in contemplation for several years. It has been found that manufacturers of small hose couplings have different standards of threads, which produce difficulties where a user has purchased couplings from different manufacturers.

Further, it has been freely stated by engineers that the small hose couplings which are used for fire and water purposes should be totally different from those which are used for gasoline and other inflammable oils. The Committee will take up the consideration of couplings, having in mind the above points for standardization of hose couplings of about ½ in. up to about 1¾ in.

Research Committee. The Research Committee has prepared a comprehensive program and is seeking coöperation with other national bodies. Research work is perhaps at this time one of the most important activities in engineering, because the war has produced shortages of various kinds of material, some of which it has been found necessary to do without and find substitutes and others of which have had their consumption curtailed. The Council has been urged to grant an increased appropriation for this work.

Committee on Machine Shop Practice. This Committee reports that at the request of the Ordnance Department it has undertaken work on the heavy-machine-tool problem and that the Department has accepted and is carrying out many of its suggestions. For instance, an order for forty-seven 102-in. gun boring lathes is being placed with the firm that developed the reinforced-concrete machine tool, and a very large number of 87-in. lathes have been contracted to the Southwark Foundry & Machine Co., who are planning in building them to make use of all the available heavy-machine-tool capacity of the eastern district. The work is still in progress.

Big Meeting at Indianapolis

The Council of the Society will hold its October meeting in Indianapolis, and the Committee on Local Sections has decided to take advantage of this and to call a meeting of the mid-western Sections to be held October 25 to 26. Cincinnati, St. Louis, Chicago, Milwaukee, Detroit, Birmingham and Indianapolis will be the chief Sections represented officially, although the invitation to the meeting will be sent to every member of the Society in the mid-western territory, and to members of local sections of other national societies, and to members of local societies.

It is expected that the Indiana Engineering Society and the Indianapolis-Lafayette Section of the American Institute of Electrical Engineers will join in with the arrangements.

A tentative program has been prepared, which calls for a two-day meeting to be held on Friday and Saturday, enabling members to leave home on Thursday night, and to stay over at Indianapolis until Sunday night if they desire. On the first day the program contemplates the Council meeting as the first event, followed by a meeting of the Committee on Local Sections, and a conference of delegates from local committees.

An informal lunch will be held at midday, and in the afternoon there will be a symposium on the mid-western fuel situation, and it is hoped to secure Mr. David Moffat Myers, the Advisory Engineer of the United States Fuel Administration as the chief speaker, and to supplement the program with addresses from the state fuel engineers of the Middle West, and from notable speakers upon the fuel question.

In the evening of the first day an informal dinner is contemplated, and an address by President Main, and by prominent local speakers.

On the Saturday the meeting will begin with a symposium on war education, including several phases of this timely subject, with addresses by Dr. C. R. Mann, Chairman of the Committee on Education and Special Training of the War Department, if he can attend, and by Dean Cooley, President-Elect of the Society, and by a number of prominent educators in the Middle West.

It is hoped that the luncheon on the second day will be held at one of the war plants of Indianapolis, and that in the afternoon visits to points of interest will be arranged, including a visit to Fort Benjamin Harrison, which is the headquarters of the Army engineers of the state of Indiana.

The arrangements are tentative, but full particulars will be published in the next issue of THE JOURNAL.

This meeting was intended to be the first of a series of joint Local Section meetings which the Committee on Local Sections hopes to hold as a desirable means of strengthening the Local Section organization and of reciprocally benefiting local members who do not often get to general meetings.

It is easily seen that such a joint meeting as the one to be held at Indianapolis may assume the proportions of a general meeting and may secure for members all the advantages of the regular convention.

War Activities in Chicago

As announced in the August issue of THE JOURNAL (page 712) the Technical Societies of Chicago have organized for war work and for placing at the disposal of the Government and other various agencies, the combined strength and resources of the engineers of that city. The organization is called the War Committee, Technical Societies of Chicago, and coöperates with the United States Employment Service.

The headquarters of the Committee is in the office of the Western Society of Engineers, 1735 Monadnock Block, Chicago.

A general meeting of the members of the Committee was held on Thursday, August 1. It was addressed by Mr. S. J. Duncan Clark, war analyst of the Chicago *Evening Post*, on the subject Recent Developments on the War Front. The address was a popular one, summarizing war conditions as given in the daily press but going more into detail in regard to the progress of the present drive and counter-attacks.

Following the address, Mr. W. F. Abbott made a brief statement of the purpose of the War Committee which is a union organization composed of two representatives from each local society and local section to coöperate in assisting the Government. The meeting was the first of the combined Committee and the attendance was about 600.

So far the activities of the Committee have been directed to sending out employment bulletins and calling attention of engineers to opportunities in the uniformed and civilian services of the Government. Further activities will be entered upon as requests from the Government departments, which have been notified of the readiness of the Committee to serve, come in.

Committee on Development of the A. S. M. E.

Initial steps have been taken for the appointment of a Committee on Development, which was suggested in the recent letter of Louis C. Marburg of the Section's Committee, reprinted in these columns (see page 694 of the August JOURNAL). The following letter, which is self-explanatory, has been sent to all Chairmen of Local Sections:

> The attached letter to the Chairman of the Local Sections Committee, Mr. D. Robert Yarnall, was discussed at a recent meeting of the Local Sections Committee which was attended by the President and Secretary of the Society.
>
> It was the feeling of all that a committee of our Society composed mainly of representatives from all the Sections as outlined in the resolutions of the A. S. C. E. might prove of great benefit.
>
> Many have had for years the ambition for the Society to enlarge its scope of activity to include fields allied to engineering. They have also hoped for a restatement of ideals expressing a broader conception of the engineer's duty to the community and of the position of the expert in public life. No finished program of organization can be offered, but a crystallization of ideas is needed and it is hoped that a plan of liberal coöperation between all engineering organizations may result therefrom.
>
> The writer was instructed by President Main to communicate with all Sections and to request that each Section suggest a representative to serve on a Committee of our Society similar in form and scope to that of the A. S. C. E. Will you, therefore, please take up this matter with your Section and make an early recommendation. It is advisable that each Section be represented by a member particularly interested in this undertaking as it is expected to have far-reaching effects upon the development of our Society. In addition to one representative from each Section the President will appoint a number of members at large and if you have any names to suggest they will be appreciated.
>
> It is proposed that an early meeting in the fall will be called at some central point to discuss the work, and while not yet authorized to guarantee the payment of mileage to delegates, the writer feels confident that sufficient funds will be available for this purpose.
>
> Hoping to hear from you at an early date, I am,
>
> Very truly yours,
>
> L. C. MARBURG.

In this connection it will be of interest to learn that the American Institute of Mining Engineers has also decided to appoint a similar committee. Three of the four Founder Societies have now taken action in this matter. It is to be hoped that other societies of national character and also local societies will provide for similar discussions, as only in this manner can the best results of this important movement be secured.

Captain May Forfeited Life in Testing Oils

The notice of the death of Capt. O. J. May of Chicago, Mem.Am.Soc.M.E., an officer of the Equipment Division of the Signal Corps, which appeared on p. 573 of THE JOURNAL for July 1918, is supplemented by the following news item, which states that in consequence of the severe strain to which he was subjected while conducting a 65-hour test of a new oil for lubricating air engines, his death is held officially to be in the line of duty.

The new oil is the result of a problem worked out with great care by officers of the Signal Corps in connection with the development of the Liberty engine. At first it was believed that castor oil must be used, or at least a blend of castor oil and some mineral oil. There seems to have been no definite determination among the aircraft organizations of the Allies as to what kind of oil should be used.

The character of the lubricating oil of the air engine is of the greatest importance, as the efficiency of the engine underlies the work of the airman, and his life often depends on its quality.

It was figured out that 5,000,000 gallons of castor oil at $3 a gallon would be required for our air service, and that quantity was not in existence. The Signal Corps then went to work on a blended mineral oil to cost 75 cents a gallon.

Captain May was set to the task of testing this oil and others on running engines. In 25 days he made 37 tests on as many engines, where five tests a week was regarded as all that any one could do. Every oil was analyzed, weighed and measured before and after the run of each engine.

Captain May was exhausted when he had completed these tests. He then set to work to make an altitude test in an air-tight building with the air in it partly exhausted and kept in that state to simulate the atmosphere at high altitudes. The Captain ran several of these tests and made one of 65 hours' duration. He stood at watch without leaving the work all that time and duly recorded his data.

The strain on Captain May's vitality was too great, and when a few days later he went on an inspection trip he caught cold in a heavy storm. He died at Takoma Park, Md., near Washington, on May 22. His work has provided the Army and Navy aviation services with a lubricating oil of the best quality at a cost one-fourth of what was estimated, and it is calculated he saved the Government fully $11,000,000. One feature of the tests of this oil is the fact that half of the quantity used may be cleaned and used over again. (*New York Times*, August 14, 1918, p. 18)

A.S.M.E. Member Cited for Bravery

Captain Horace L. Smith, Jr., Mem.Am.Soc.M.E., has been cited for bravery in action, along with his entire company. Captain Smith is in command of Co. D, First Engineers, and distinguished himself in battle at Cantigny which the Americans captured and held against superior enemy forces. Captain Smith's company lost 45 men and two officers, killed during the action.

The First Engineers is a part of the First Division, Regular Army, commanded by Major General Bullard. The citation of bravery read as follows:

"Although handicapped at the beginning of the action by the loss of two officers killed and one wounded, nevertheless, it carried out its mission in a highly efficient and satisfactory manner; in addition to its duties as an engineer company, it acted as an infantry reinforcement, and during the three days suffered severely in killed and wounded."

Captain Smith was recommended for the citation for bravery in battle by the non-commissioned officers of his command, who declared that they were proud to serve under him.

Lieutenant-Colonel Parsons Now in Command of the Eleventh Engineers

Lieut-Col. Wm. Barclay Parsons has recently been placed in command of the Eleventh Regiment of Engineers, now in France for over a year. Previous to entering the war Colonel Parsons had held the rank of brigadier general and chief of engineers with the New York National Guard. He was chief engineer of the Rapid Transit Commission of New York from 1894 to 1905; a member of the Isthmian Canal Commission, 1904; advisory engineer of the Royal Commission on London Traffic, 1904; member of the Board of Consulting Engineers, Panama Canal, 1905. He has been a trustee of Columbia University since 1897, having been graduated in 1879, and is the holder of several degrees. He is a member of the American Society of Civil Engineers, the Institution of Civil Engineers, Great Britain, Société des Ingénieurs Civils de France, and has written several books and papers on engineering subjects.

In May 1917 Mr. Parsons received a commision as major and on the 14th of the same month sailed for France on a special mission for the Government to look over the railroads of that country.

Navy Factory's Year Record in Building Flying Boats

It is a pleasure to publish the following information relative to the accomplishments of one of the members of the Society:

On July 27, the anniversary of the date on which the building of the naval aircraft factory at Philadelphia was authorized, Rear Admiral Taylor, Chief of the Bureau of Construction and Repair, which built and operates the plant, reported to Secretary Daniels the satisfactory record made in its erection and operation, under the direction of its manager, Naval Constructor F. G. Coburn, Mem.Am.Soc.M.E. In recognition of this, the Secretary addressed a letter to Naval Constructor Coburn, as follows:

"The department desires to express its appreciation of your ability shown in organizing the naval aircraft factory and bringing it, as its manager, to its present state of efficiency. One year ago the construction of the naval aircraft factory was authorized by the department, and you were detailed as its manager. This factory has been built in accordance with plans prepared by you, and the records show that forms for the first flying boat were laid October 12, while the building was not completed until November 28. The first flying boat was given its successful trial flights on March 27, 1918, and since that date a steadily increasing rate of production has been observed. It is noted that the first order for 50 large flying boats has been completed and the greater part are now flying over British waters.

"It is believed that the creation in the space of one year of one of the largest aircraft factories in the country stands as a conspicuously successful example of the Navy's preparation for war."

The contract for the aircraft factory was awarded August 6, 1917, and work was begun on the same day. The original factory had a floor space of 160,000 sq. ft. An extension, which will give an added space of 55,400 sq. ft., was begun on February 26, 1918, and is now practically completed. (*Official Bulletin*, July 27, 1918, p. 5)

AMONG THE LOCAL SECTIONS

THE four years' work of the Committee on Local Sections, first as a special committee of the Society and now recently as a standing committee of administration and one of the six fundamental committees of our organization, demonstrates the value of Local Sections as an agency for furthering the several phases of the Society's work and for reaching the individual member and rendering him effective service.

However, there has been one limiting factor—the number of the Sections which have been established. In certain centers, such as Boston, Chicago and St. Louis, Local Sections of our members have been operating for some years, and members residing in these centers have secured all the advantages which come from the Local Sections organization, whereas members in other large centers where Sections have not yet been established, such as Pittsburgh and Cleveland, have not secured these advantages. In no two local centers has there been similarity of conditions, so that the matter of establishing a Local Section has been a problem unto itself in each place, and organization of local members has only come about when all concerned have been convinced of the advantages and when the local members themselves have decided upon utilizing their initiative in requesting organization.

This latter is the determining factor in the progress of the local sections movement in all societies and precludes any undue stimulation of the movement on the part of the governing bodies or any committees at headquarters of the national societies. Therefore, if the progress of organization into local groups has been slow in some desirable territories, it has been on account of the fact that the local members have for some reason or other deemed it wise to defer organization.

Now, however, comes a turning point in the history of the Local Sections and a new factor is introduced into the equation which requires local members to review their local conditions, especially in relation to the existing local societies and to determine upon a manner of organization. The Committee on Local Sections becomes one of the six main committees of the Society; the Local Sections organization therefore becomes constitutionally one of the supporting pillars of the Society. It is no longer a question of whether or not it is desirable for the Society to encourage Local Sections; it becomes imperative that the Society have Local Sections to continue to function.

This condition of things has not been brought about suddenly by constitutional amendment produced autocratically, but is merely the outcome of a number of tendencies extending over as many years as the Local Sections organization has been in existence; and, furthermore, these tendencies have not all been proposed by the Local Sections themselves—they have been originated by the central committee of the Society which has long since recognized the coming of the new order of things.

For five years decentralization in government has been under discussion in the councils of our organization, with such success that the latest proposed amendment to the Constitution means a marked step in this direction. It will be but a short while before such decentralization is completely accomplished and the power of government placed in the hands of the entire membership forever.

If the constitutional amendment securing this decentralized government goes into effect next spring, and its execution should be placed in the hands of the Local Sections, the elements in the Local Sections organization heretofore not at all similar by virtue of the unique set of conditions in each Section center will need coördination. And, as already mentioned, some of the centers where Sections do not exist, but where the local membership is strong, must be brought into committee relations and the whole Local Sections organization must be well rounded out so that all disparities are removed and the new machinery of government can be started up smoothly.

Incidentally, for some time there has been discussion regarding the desirability of completely coördinating all organized groups of engineers of whatever kind for the purpose of securing for engineers the voice in the community to which they are entitled. A rounding out of the local sections organization of the national societies such as we are about to accomplish in our own Society will go a long way toward rendering such a unification of engineering society activities effective.

The Committee on Local Sections foresees a large amount of work in bringing its organization to a condition of inclusion of all localities, but this can be very much simplified if the full coöperation of the local center is secured in each case. A certain amount of uniformity is necessary in the organization of Sections, but the difference of local conditions must of course be realized. The following thoughts regarding Local Sections and local societies might be advanced at this time:

The basis of social relations is the community, in which the engineer is one of the elements. The fundamental organization of engineers in the community is the local engineering society which includes in its membership all engineers of whatever training or experience, or in whatever field of work. Through this organized local society the engineers have their voice in the affairs of the community. The local society may be large enough to render it desirable to sectionalize its activities into civil, mining, mechanical, electrical or other engineering. However that may be, the local society still remains the unit and so long as the engineer continues to reside in the community he secures his voice in its engineering affairs through the medium of his local society. That is all he requires and that secures for him his recognized standing. Therefore, the local society must be regarded as paramount in engineering organizations.

The limit of usefulness of the local society to the individual member is reached, however, when he removes from the community and establishes himself in another territory. He must make entirely new connections and must bide his time for his standing in a new community to be recognized. There is also another limit of usefulness of the local society in its relation to the engineer at large and to the public: the local society specializes in local conditions and confines its interest to such conditions. Its meetings are usually limited in attendance and its publications have only a small circulation, and, except in a few special cases, its influence does not extend very far beyond its center of operations.

Here is where the utility of the national society comes in. It secures for its members a national and sometimes international connection, so that the limitation of community residence is entirely removed. Its meetings and publications are national and international in scope, so that its influence through these media is practically universal.

The connection between the local and national societies is established in the following manner: The activities of the national society are supported entirely by individual members, who are, in turn, usually members of local societies; and so, while the fields of operations of local societies and national societies are entirely separate and distinct, the agents perform-

ing these operations are one and the same. The two kinds of organizations therefore become inseparable and interdependent.

It is not necessary to justify further the existence of both organizations and the above comparison has been made merely to introduce the idea by which our own Local Sections organization and the local societies may be brought up to the point of active coöperation and complete coördination.

In practically every center in which we have a Local Section there is a local society, and it is the business of our section to preach the gospel that that society is the authority in the community.

In centers where we have no Local Sections there is usually, likewise, a local society and, bearing in mind that in all such centers we need organization and government, our local members should take the initiative and open up negotiations with the local society with a view to determining how our members may organize and work for the government of the national society without detracting from the autonomy of the local society.

Behind the whole organization movement of which, of course, our Society is but a small part, there is the great incentive that there remains an army of engineers in this country who have not yet responded to any calls for organization to secure for the engineer the recognition in public life which he merits. The engineering profession is lacking in missionaries—the men who will emerge from the natural conservatism which is inherent to their professional training and who will blaze the way into the halls of community government in which the engineer has so far been conspicuous by his absence.

SECTIONS REPORTS AND PROGRESS FOR THE YEAR

ALTHOUGH in a few cases the war seriously upset the plans of the executive committees for the season just closed, nevertheless on the whole the committees were able to maintain the development of the Sections organization and to carry out a progressive year's work. Naturally the meetings have changed in character somewhat and in a number of instances committees were called upon to fill programs quickly; many war subjects and war speakers have been introduced and much valuable information upon war topics brought out at the meetings.

In the last issue of THE JOURNAL were listed the more important papers contributed by the Sections. Some of these papers have already been published and others appear in this issue. While it is not yet possible to publish all the papers received and while it is likewise not yet possible to publish material immediately upon receipt, still the Publication and Papers Committee is alive to this condition and is considering ways and means of remedying it, so that the Sections may receive the prominence in the publications which their large contributions to the activities of the Society merit. Many of the papers presented before Sections are given in collaboration with local societies, and if the local society issues a publication, the paper appears in good season in the local journal. What we want is some arrangement whereby simultaneous publication of Local Sections papers may be made in the local journal and in the national journal, and then the interests of both societies will be best served.

The new executive committees, which, under the present method of government of Sections, assume office on July 1, are taking the opportunity afforded by the out-of-season period to familiarize themselves with the duties of their office and of laying their plans for the next year's work. In many cases the committees have already had their organization meetings. The transfer of records from the old to the new officers is now made in a very simple manner through the medium of what are called Section record books—loose-leaf binders with standard sheets which have been issued to each Section by the Committee on Local Sections and which contain just the information the chairmen and secretaries require in discharging their duties of office. This simple method saves a great deal of time when the personnel of the committee changes.

The thanks of the Society and of the members at large should be duly extended to the executive committees whose terms of office have just expired for the personal time they have devoted and the labor they have spent in continuing and fostering this fundamental activity. The amicable relations with local societies and with local groups of other national societies which were universally enjoyed by our Society are the subject of comment by all, and these relations are entirely due to the fine spirit with which the local committees have carried on their voluntary work.

As in previous years, the committees going out of office have been requested for brief reports of their activities for the year for publication in THE JOURNAL. Not all of these reports have yet come to hand, which is natural considering the heavy calls upon the time of every one. Those which have been received, however, are published in abstract below.

ATLANTA

The Section has continued to meet with the Affiliated Technical Societies of the City of Atlanta.

It was decided early in the year to hold meetings monthly and have a paper upon an appropriate subject presented at each meeting. This program was not quite carried out, however, owing to the war conditions.

The engineering paper of the year was entitled, The Effect of Fuel Economy of Different Arrangements of Baffles in Boiler Tubes, by Mr. W. G. Eager.

OSCAR ELSAS,
Section Chairman.

BALTIMORE

Six meetings were held this season, one being of the nature of a symposium of engineering problems of the canning industry.

At the November meeting a notable paper was read by Mr. W. L. De Baufre of the U. S. Naval Engineering Experiment Station on the subject of Evaporation. Professor Christie, at the same meeting, discussed the question of Municipal Ownership of Public Utilities.

At the May 22, 1918, meeting M. W. H. Blood, of the American International Shipbuilding Corporation, read a paper entitled Hog Island Shipyard; the Greatest in the World.

WM. W. VARNEY,
Section Chairman.

BIRMINGHAM

The Section retained its affiliation with the Alabama Technical Association, which includes all members of the national engineering societies residing in the state of Alabama.

Five meetings were held, at three of which phases of the war situation were discussed. The May 16, 1918, meeting was an all-day joint meeting, at which Secretary Rice was present.

J. H. KLINCK,
Section Chairman.

BOSTON

During the year the Boston Section held six regular meetings in addition to the Annual Dinner and a joint meeting with the A.I.E.E. Section. All these meetings were duly reported in THE JOURNAL.

The Annual Dinner of the combined engineering societies was held on April 30, and among the gentlemen who spoke were: Alfred D. Flinn, Secretary of the Engineering Council, who dealt with the Work of the Council; and W. H. Blood, Jr., of the American International Shipbuilding Corp., who delivered a lecture on Hog Island, the Greatest Shipyard in the World. Short addresses on subjects of the day were given by Major-General H. F. Hodges, in command at Camp Devens, and Major Andrew J. Peters, of Boston. Motion pictures were also shown illustrating the adaptability of a new rudder which has been perfected by H. O. Westendarp, of the General Electric Company.

The Annual Meeting of the Section took place at the Engineers' Club on the evening of May 29. Dr. Charles H. Eaton of the Shipping Board, Emergency Fleet Corp., delivered an address on America at the Gateway of Destiny.

No meetings have been planned for the summer months.

A. C. ASHTON,
Section Chairman.

BUFFALO

The Section has continued as an affiliated branch of the Engineering Society of Buffalo and has passed through its seventh season successfully.

The local society held a large number of meetings, many upon mechanical engineering subjects, all of which have been recorded in THE JOURNAL from time to time.

The new committee is a very active one and prospects for the coming year are exceedingly good. The committee already has some good papers in prospect.

F. E. CARDULLO,
Section Chairman.

CHICAGO

On October 24 a meeting of the executive committee was held with the Sections Committee who were visiting Chicago, and the question of coöperation with other societies in Chicago was discussed, which resulted in a movement to hold joint meetings with the Western Society of Engineers and the Chicago Section of the American Institute of Electrical Engineers.

The first regular meeting was held on November 16 in connection with the Council Meeting, and was attended by some 180 members and guests. The address was given by Lieut.-Col. Peter Junkersfeld on Cantonment Construction.

Three such meetings have been held, two in the rooms of the Western Society and one in connection with the meeting of the National Society for the Promotion of Engineering Education, at Northwestern University. At the first, Mr. C. F. Kettering spoke on the Development of the Internal-Combustion Engine, and at the second, Messrs. Berg and Morgan presented papers, the first on The Future Possibilities of Steam Economy, the second on Modern Condenser Practice.

The meeting at Northwestern University was on the subject of Technical Training for the War and After, and included short addresses on Present Needs of Industry, The Future Outlook, The Nature of Training Which Should Be Given, and The Employment of Women Workers in War Industries.

The March meeting of the Section took up the question of the fuel situation and addresses were given by Joseph Harrington and by Prof. H. H. Stoek. Prof. Stoek spoke on the question of Fuel Storage, and Mr. Harrington outlined the fuel situation and advocated a system of power-plant regulation such as is now being put in force by the Fuel Administration.

A short meeting held in May was addressed by John Erickson, City Engineer, who presented a paper on the New North-Side Tunnel and the Mayfair Pumping Station of the City Water Works.

Auxiliary activities of the Section during the year have been coöperation in the sending out of notices for the Government of requirements of engineers for Signal Corps Service, for the Refrigeration Regiment, for Submarine Service, and for the Ordnance Department.

The Section has also coöperated in the sale of the bonds of the Third Liberty Loan, and has joined with the other local sections and local societies of Chicago in establishing the War Committee of Technical Societies which is now issuing bulletins on Government needs, is coöperating with the State Fuel Administration in the power-plant census, and has held one popular summer meeting at which some 600 were present, addressed by S. J. Duncan Clarke on The Present War Situation in France.

A. D. BAILEY,
Section Chairman.

CINCINNATI

On October 18, 1917, Mr. F. O. Clements addressed a joint meeting of this Section with the Engineers' Club of Cincinnati on the Research Laboratory Applied to Industry. A brief abstract of this paper appeared in the December 1917 issue of THE JOURNAL.

Mr. J. E. Freeman was the speaker at the February 21 meeting and had for his subject the Construction of Concrete Ships and Barges.

A joint meeting with the Engineers' Club was held on the afternoon and evening of March 21, 1918. The afternoon session began at 2:30 and was presided over by George W. Galbraith. Mr. Henry Ritter, general superintendent of the Lunkenheimer Co., spoke on Shop Kinks, and the paper was discussed by A. Wood of the Niles Tool Works Co., Hamilton, and George Langen of the Cincinnati Planer Co. The second paper, on The Economic Use of Coal by Communities, was delivered by Prof. John T. Faig and was illustrated by lantern slides.

The evening session was presided over by the president of the Engineers' Club. Mr. C. U. Carpenter, vice-president and manager of works of the Recording & Computing Machines Co., Dayton, O., spoke of the training of some thousands of women, who had had no previous training in mechanical lines, for the manufacture of time fuses for Russian shrapnel.

At the meeting on May 11 the guest of honor was Secretary Calvin W. Rice, who delivered an inspiring address on the activities of the Society. Mr. F. A. Geier and Mr. George W. Galbraith also gave short talks.

An automobile trip to Dayton, O., was arranged for the members of the Section on May 25 and the party was given special permission to visit the famous Wilbur Wright Aviation Field near Dayton. During the afternoon, members were given an opportunity to inspect the plants of the Dayton-Wright Aeroplane Co. and the Recording & Computing Machines Co., the latter of which firms has accomplished much in its rapid and efficient method of training women for industry.

In response to a resolution offered by Dean M. E. Cooley of the University of Michigan before the Detroit Section, a committee was appointed by the chairman of the Cincinnati Section on the intensive training of women for industry, consisting of the following: George Langen, J. B. Doan and R. T. Hazleton. Through the efforts of this committee an intensive course in mechanical drawing was begun at the Ohio Mechanics' Institute, Cincinnati, on June 24. About forty young women presented themselves for this work and a number of them are now taking the places of men who have been called to the Service. It is the intention of the committee to continue its work.

G. W. GALBRAITH,
Section Chairman.

CONNECTICUT

The Connecticut Section, which was organized last year with five Branches at New Haven, Hartford, Bridgeport, Waterbury and Meriden, respectively, has passed through a successful season although all Branches have not been uniformly active.

It is felt that the work of the Section has been of service to engineers of the state and that as the organization develops this work will be enhanced in value.

The Connecticut plan provides for fall and spring meetings at New Haven and additional meetings at each of the Branches from time to time. Such meetings have been held this year.

Reports from all Branches have not yet come to hand, but the following typical report has been received from the Bridgeport Branch:

The Bridgeport Branch of the Connecticut Section has been coöperating with the other Branches in the state, copies of the

minutes of all executive meetings having been exchanged. They have also worked jointly with the New York Section and have been represented in the United Engineers' Sessions in New York City, and also on the Mayor of New York's special sessions for the Allied Engineering Societies, which had mainly to do with labor problems appertaining to mechanical engineering work. The Branch was also represented at a banquet given in honor of the British Labor Commission in New York.

The general meeting held on April 24, 1918, was most successful. This being a banner occasion, almost the entire membership was present. The combined meeting held on June 21 with the Bridgeport Manufacturers' Association and Chamber of Commerce was a particularly happy thought on the part of President Bilton, of the Manufacturers' Association. This last general meeting was a most successful affair and the papers read on the Conservation of Fuel will become a guide for carrying on this work.

Papers have not been as numerous as had been hoped possible but have been valuable, bearing on the subject of gages.

HENRY B. SARGENT,
Executive Committee Chairman.

DETROIT

Meetings of the Section are now being held in coöperation with the local sections of other societies and with the Detroit Engineers' Society in the rooms of the Chamber of Commerce.

The National Committee on Local Sections visited Detroit on October 25, 1917, when a few select brief papers were presented on primary topics.

The annual meeting was held on May 5, 1918, in conjunction with the Detroit Engineering Society. Important resolutions by Dean Cooley on the training of women for drafting-room work were adopted and transmitted to all engineering organizations.

The Detroit Section is looking forward with a great deal of anticipation to the coming of the Society to the city in the spring of next year and is already beginning to make arrangements for the distinguished guests.

G. W. BISSELL,
Section Chairman.

ERIE

The Erie Section has continued its coöperation with the Engineers' Society of Northwestern Pennsylvania and held a joint meeting with the society on November 13, 1917. On May 3, 1918, Mr. James Burke presented a paper on The Conservation of Fuel.

The Section is still a young one, having only just passed through its second year of operation and that under the exceptional conditions of war.

J. F. WADSWORTH,
Section Chairman.

INDIANAPOLIS

The Indianapolis Section has been coöperating with the Indiana Engineering Society, the local section of the A. I. E. E., and the local Chamber of Commerce.

An important joint meeting was held on June 25 of this year at which a number of papers of local and general interest were presented.

One other meeting was held on November 7, 1917, and was duly reported in THE JOURNAL.

A symposium on Fuel Conservation was held on May 10, 1918. Secretary Rice gave an address on The Relation of the National Society to the Section and the Relation of the Engineer to the War.

W. H. INSLEY,
Section Chairman.

LOS ANGELES

The Section has been coöperating with the joint technical societies of Los Angeles, which have been holding luncheon meetings throughout the year at which short talks have been given by speakers furnished by the various societies, in accordance with a program laid out in advance.

On November 24, 1917, an interesting visit by the societies was made to the top of Mt. Wilson and the Mt. Wilson Solar Observatory.

President Hollis visited the Section early in the year and also addressed the Student Branch at Throop Polytechnic Institute.

F. G. PEASE,
Section Chairman.

MILWAUKEE

Milwaukee has just completed another good year, its meetings being largely attended. The meetings are still being held at the City Club.

The first meeting of the season was held on October 23, 1917, when the Section entertained the National Committee on Local Sections. Luncheon was served at the Milwaukee Club and a visit paid to the Allis-Chalmers plant. In the evening a large number of local engineers attended a dinner and took part in a discussion of Society affairs.

On November 14, Mr. B. E. Fernow gave an illustrated talk on the Design and Application of Magnetic Clutches. On January 16, 1918, Mr. W. Alexander spoke on Electric Locomotives on the Chicago, Milwaukee and St. Paul Railway. On February 13, 1918, Mr. E. S. H. Baars addressed the section on Cold Accumulators and Their Application to the Refrigerating Industry. A joint meeting with the Electricals was held on March 13 when Prof. C. M. Jansky spoke on Science in War. A successful meeting was held on April 10 under the auspices of the American Society of Refrigerating Engineers, and C. L. Portier gave an illustrated lecture on Automatic Control Apparatus for Temperature. On May 8 Mr. N. J. Whelan addressed the Section on The White Coals of Wisconsin.

W. M. WHITE,
Section Chairman.

MINNESOTA

A very cordial feeling exists between the Minnesota Section and the other engineering interests and societies of the state. The Minnesota Joint Engineering Board is becoming a factor in society affairs in the Northwest. The Board has headquarters in the Twin Cities and practically all the engineering associations in the state have applied for membership in it.

The Board recently appointed a committee to draw up a permanent plan of organization of an engineering club. Four alternatives are under consideration: (1) An all-inclusive organization for professional engineers, juniors and associates, with a different status for each, (2) an organization of members of the four national societies, (3) an organization of national society members with a limited number of associate members, (4) an organization of professional engineers only.

Three elements are considered as essential to the organization: professional, social and civic; and it has been suggested that affiliation be made with a civic body so that the entire community may be bettered.

A joint meeting of the sections of the national societies was held in Duluth on May 20.

H. LEROY BRINK,
Section Chairman.

NEW ORLEANS

The second year's work of the New Orleans Section has been a successful one. As before, meetings have been held in entire coöperation with the Louisiana Engineering Society.

Five meetings were held during the season. On September 7 Mr. F. J. French read a paper on Shipbuilding which was published later in THE JOURNAL. The January 12, 1918, meeting was a smoker with the Louisiana Engineering Society. On February 11, 1918, Mr. P. E. Lehde gave an address entitled, Some Notes on Wireless Telegraphy, and on March 11 Mr. A. M. Lockett described the New Orleans Industrial Canal. On May 13 Secretary Rice visited the Section, and Hon. T. F. Carlisle, British Consul, spoke on Britain and the War during the last twelve months.

H. L. HUTSON,
Section Chairman.

NEW YORK

During the first half of the season the plans of the Section were somewhat disorganized on account of the almost complete dismem-

berment of the Executive Committee. After considerable effort the committee was reorganized and an aggressive program was undertaken with considerable success.

Reports of the meetings held have been published in full in THE JOURNAL, the discussion at the meeting on Non-Essential Industries on February 21, 1918, being given place by the Publication Committee in the technical section.

On April 9, 1918, a unique gathering was held in the form of a joint meeting of the Metropolitan Student Branches and the New York Section. The Branches were responsible for the conduct of the meeting and carried the program through in a very creditable manner.

JOHN H. NORRIS,
Section Chairman.

ONTARIO

This section was established in May of last year.

On January 29, 1918, Mr. F. B. Ward addressed the Section on the Influence of Munition Manufacture and Other War Work on Machine-Shop Practice. On March 25 a meeting of the Joint Committee of Technical Organizations was held and several speakers addressed the Section on war subjects. On April 18, 1918, Mr. W. M. Wilkie spoke on Heat Treatment of Low-Carbon Steels.

A well-attended meeting of the A.S.M.E. Ontario Section and the Toronto Branch of the Engineering Institute of Canada was held in the lecture room of the Engineers' Club on July 3, at which two subjects were presented.

The first was a very interesting paper by Edward Maybee on Patents of Invention which covered particularly that part of the patent field of interest to engineers, and a number of points which are generally not well understood were explained very clearly.

The second subject was an address by Mr. Holmes, of the Invalid Soldiers' Commission, on The Training of Disabled Soldiers in the Industries. The training of returned soldiers falls into three periods: that in the hospitals, then in the reëducation schools, and lastly in the shops of the industries themselves. Mr. Holmes dealt with this last department and explained the organization and methods of handling the work. It is with this industrial phase of the training that the engineers and employers should be most closely in touch, because here they can help most.

Mr. Holmes explained how the preliminary survey is made of each plant before men are placed there and that a careful supervision is kept over the men and their work by the government commission during the period of their instruction. The men receive pay from the government and instruction from the firm. Over 90 per cent of the men so placed have made good and are now earning or making good progress toward earning, a comfortable income.

The principal point brought out was that the returned men should not be dumped upon the industrial field and left to shift for themselves, but that their cases must be studied individually and the men allotted to positions suiting not only each man's natural capacity but also the nature of his wounds or physical deficiency.

R. W. ANGUS,
Section Chairman.

PHILADELPHIA

Early in the fall of 1917, the Executive Committee met and arranged the entire program for the year, completing all arrangements by the middle of September. In spite of the pressure of war work, none of the speakers failed to keep his appointment, much to the gratification of the committee and the membership.

On October 16 the first meeting of the year was held jointly with the Philadelphia Engineers' Club in Witherspoon Hall. President Vogelson of the Engineers' Club presided. Mr. Homer L. Ferguson, President and General Manager of The Newport News Shipbuilding & Dry Dock Co., gave an excellent address upon The War's Effect on Merchant Shipbuilding. At the time of this meeting the country had just become awakened to the necessity and importance of the shipping program; his address, therefore, was a very timely one. About six hundred engineers from Philadelphia and vicinity attended the meeting.

The meeting of November 27 was given over to a discussion of the activities of the Local Sections of the Society. Mr. D. Robert Yarnall, the chairman of the National Committee on Sections, opened the meeting with a statement in which he emphasized the fact that some of the newer western Sections have been extremely active and progressive, and that Philadelphia would have to use every possible means to equal the pace set by the western Sections. The Local Section had the pleasure of meeting at this time Ernest Hartford, Secretary of the Committee on Sections, and William Bullock, Assistant Secretary of the Society. Professor Walter Rautenstrauch, of Columbia University, gave the leading paper of the evening, entitled Manufacturing in Relation to Banking, Research and Management.

On December 11 a paper entitled Offensive Against the Submarine was presented by Joseph A. Steinmetz at a joint meeting of the Franklin Institute and the A. S. M. E., held in the Franklin Institute Auditorium. The lecture was fully illustrated with lantern slides and moving pictures.

On January 22 The War on Land and Sea was discussed at the Engineers' Club by Professor Cathcart, who is a retired officer of the United States Navy and has studied the situation closely. In introducing the subject, Professor Cathcart said:

"It may be safely said that the present war has had no parallel since the darkest days of barbarism. Prussian autocracy is the enemy of no one nation or group of nations, but of all free peoples the world over. For forty years that savage government has made deliberately planned war for world-dominating aims the chief industry of its subjects. To further these aims, in their political and financial bearing, sinister German intrigue has been active everywhere. From Bagdad to Buenos Aires there is no land now which is not stained by the slime of German plotting, of German money lavishly spent for basely treacherous ends."

A lecture that was quite new in its field was given by Carl G. Barth on February 26. Mr. Barth took as his subject The Income Tax, an Engineering Analysis, in which by a thorough mathematical analysis of the Federal Income Tax law, represented graphically in several ways, he clearly set forth the defects of this law. Mr. Barth has promised at a later date to give to the Philadelphia Section a supplement to The Art of Cutting Metals. This work of the late Dr. Frederick W. Taylor is well known as a masterpiece on the subject. A revision of the work by a man of Mr. Barth's experience is looked forward to eagerly by the engineering fraternity.

Few men realize the very important part that the Bureau of Standards has taken in the war. Dr. S. W. Stratton, director of the Bureau, stopped his work long enough to visit Philadelphia and deliver to a very large audience in Witherspoon Hall on March 27 a paper on The Relation of the Bureau of Standards to the War. Views and descriptions of very delicate measuring instruments used by Dr. Stratton in his work were shown.

On April 23 the Section had the pleasure of entertaining the Council of the National Society at a dinner meeting held in the Adelphia Hotel, Philadelphia. The following members of the Council attended: Messrs. Rice, Benjamin, Plunkett, Orrok, Marburg, Thomas, Green, Rautenstrauch, Hartness, Wiley, Alford, Stevens, Main and Barr.

George Satterthwaite, vice-president and general manager of the Tacony Ordnance Corporation, spoke on May 28 to a large audience in the Engineers' Club auditorium. Mr. Satterthwaite's subject was the Manufacture of Ordnance Forgings. Supplementing Mr. Satterthwaite's paper a moving-picture film giving in detail the manufacture of 9.2 high-explosive projectiles was shown. These films were loaned through the courtesy of *Machinery* and the Industrial Press.

The following were elected officers for the year beginning July 1, 1918: C. N. Lauer, chairman; John P. Mudd, secretary; H. B. Taylor, L. F. Moody, W. B. Murphy and L. H. Kenney for executive committee.

During the year 1917-1918 four joint meetings were held with other engineering societies in Philadelphia. The joint-meeting idea is a good one, and it is the hope of the Local Section that there will be more of the "get together" among the numerous engineering societies in Philadelphia.

Three papers presented at meetings of the Philadelphia Section this year have been published in THE JOURNAL of the Society, and four have been published in the *Journal* of the Engineers' Club. The paper presented by Homer L. Ferguson on The War's Effect on Merchant Shipbuilding was also published in the *Marine Review*, and extracts of it were printed in several other trade journals.

L. F. MOODY,
Section Chairman.

PROVIDENCE

As heretofore, the functions of the Local Section at Providence are accomplished through an affiliation with the Providence Engineering Society. The local society has made uniform progress during the past year and is now well established in its adequate and permanent quarters. The activities of the local committee have been continued under the fire-insurance, designers' and draftsmen's section, machine-shop, efficiency, structural engineering, chemical, power, municipal, highway and water supply, industrial and technical education, student, and municipal engineering sections. Each section held meetings monthly at which papers on suitable technical topics were presented and discussed.

The annual outing of the Providence Engineering Society together with the American Chemical Society was held at the Oakland Beach Yacht Club on June 29. Many attractions and sports were arranged and all in attendance had a very enjoyable time.

ROBERT W. ADAMS, *President*,
Providence Engineering Society.

ST. LOUIS

There has been a growing feeling in St. Louis that considerable attention should be paid in the Section to subjects touching upon the human side of engineering work. Accordingly, at the first meeting this year, September 21, a number of vital-interest questions to mechanical engineers in St. Louis were discussed by prominent members, all of whom indicated very clearly that there was a large amount of work laid out for the coming year and that it was to be carried forward with great earnestness. This idea was confirmed by the visit of President Hollis the next month, who emphasized this policy as the first and foremost one of service to the engineering profession.

Six regular meetings of the Section were held during the year. The November 23 meeting was in the form of a testimonial dinner tendered to Mr. John Hunter by the Associated Engineering Societies of St. Louis, which was reported in THE JOURNAL.

An exceedingly timely meeting was that held on March 29, 1918, when Dr. Isaac Lippincott addressed the Section on Economic Reconstruction After the War.

R. L. RADCLIFFE,
Section Chairman.

SAN FRANCISCO

The meetings have taken the form of joint meetings of the sections of the Mechanical, Civil, Mining and Electrical Engineers, and the American Chemical Society. At the first of these joint meetings, on October 25, 1917, a dinner was tendered to President Hollis on the occasion of his visit to the Pacific Coast. The general subject for the evening was the Relation of Engineering to the War and speakers from each society took up the particular branch of engineering represented by his society. Doctor Hollis responded with an inspiring address on the Moral Influence of Engineering and Efficiency.

A similar joint meeting with four speakers on war topics was held on March 20, 1918.

B. F. RABER,
Section Chairman.

WORCESTER

The biggest event in the Worcester Section this year was the Spring Meeting of the Society held there from June 4 to 7, 1918. This has been fully reported in THE JOURNAL. Most of the activities for the year were taken up in the preparation of plans for this meeting and their execution.

On November 22, 1917, President Hollis and Prof. L. P. Breckenridge opened a discussion upon Fuel Conservation.

GEORGE I. ROCKWOOD,
Section Chairman.

ROLL OF HONOR

APPELQUEST, J. A., Second Lieutenant, Aviation Section, N. A.

BASSETT, CYRUS W., Corporal, Headquarters Co., 305th Ammunition Train, American Expeditionary Forces, France.

BAYNE, GEORGE H., Captain, Ordnance Officers' Reserve Corps, Ordnance Department, U. S. Army.

BICKLEY, C. D., Second Lieutenant, Utility, Quartermaster Corps, U. S. Army, Camp Dix, N. J.

BLEE, H. H., Captain, Air Service, U. S. Army, Airplane Engineering Department, Bureau of Aircraft Production, McCook Field, Dayton, O.

BOLTON, WRIGHT, JR., Chief Machinist's Mate, U. S. Naval Aviation Station, France.

BRYCE, RICHARD M., Ordnance Corps, U. S. N. A., American Expeditionary Forces, France.

CORP, CHARLES I., Captain, Sanitary Corps, U. S. Army, assigned to Fort Oglethorpe, Ga.

DEEDS, EDWARD A., Colonel, Signal Corps, U. S. Army, assigned to Washington, D. C.

DOAR, E. MARION, Machinist's Mate, U. S. Navy, Candidate Steam Engineers' School for Officers, Stevens Institute of Technology, Hoboken, N. J.

DONALDSON, HAROLD R., Flying Cadet, Barracks No. 54, Kelly Field No. 2, San Antonio, Tex.

DUNTON, PHILIP R., Sergeant, Tank Corps, Headquarters Co., 326 Battalion, Camp Colt, Gettysburg, Pa.

DURGEE, ANDREW B., First Lieutenant, Air Service Department, Military Aeronautics, Taliaferro Field, Hicks, Tex.

EAGER, W. G., Lieutenant, Senior Grade, U. S. Naval Reserve Force.

FLAD, ALBERT E., Marine Reserve Flying Corps, Navy Yard, Philadelphia, Pa.

FLANIGAN, EDWIN B., First Lieutenant, Quartermaster Corps, U. S. Army, commanding M. S. T. U. 405, American Expeditionary Forces, France.

FRENCH, E. V., Major, Quartermaster Corps, N. A., American Expeditionary Forces, France.

GILL, MURRAY F., 5th Officers' Training Camp, Fort Monroe, Va.

GRADY, WILLIAM H., Candidate, Officers' Training Camp, Camp Zachary Taylor, Ky.

GRISBAUM, L. D., U. S. Naval Reserve Force, Marine Engineers' Training School, Hoboken, N. J.

HARRISON, H. L., Ensign, U. S. Naval Reserve Force, Navy Department, Bureau of Ordnance, Washington, D. C.

HOOD, WARREN B., Captain, Ordnance Officers' Reserve Corps, Ordnance Department, U. S. Army, assigned to Watertown Arsenal, Watertown, Mass.

HOOVER, A. PEARSON, Major, Quartermaster Corps, N. A., assigned to Boston Quartermaster Terminal, Boston, Mass.

HYDE, G. C., Captain, Utility Detachment, Camp Beauregard, Alexandria, La.

KARR, ALFRED D., Second Lieutenant (military aeronautics), Signal Corps, N. A., Air Service Flying School, Chanute Field, Rantoul, Ill.

KLINCK, J. H., Major, Quartermaster Corps, N. A.

KOSSIF, N., Cadet, U. S. School of Military Aeronautics, Mass. Inst. Tech., Cambridge, Mass.

LAFORE, JOHN A., Major, Ordnance Officers' Reserve Corps, Ordnance Department, U. S. Army, assigned to Washington, D. C.

LANGSTROTH, C. B., Captain, Ordnance Officers' Reserve Corps, Ordnance Department, U. S. Army.

MCLUNDIE, ARCHIBALD S., First Lieutenant, Ordnance Officers' Reserve Corps, Rock Island Arsenal, Rock Island, Ill.

MILLER, H. W., Captain, Railway Artillery Section, Ordnance Department, U. S. Army, American Expeditionary Forces, France.

MURPHY, E. A., Second Lieutenant, Aviation Section, N. A., Bureau of Aircraft Production, Purchase Division.

NICHOLS, GEORGE B., Captain, 56th Engineers, Washington Barracks, District of Columbia.

RUDDY, WILLIAM, First Lieutenant, Ordnance Officers' Reserve Corps, Ordnance Department, U. S. Army.

TERRY, CARLYLE M., Chief Machinist's Mate, U. S. Naval Reserve Force, Steam Engineering School, Pelham Bay, N. Y.

THOMPSON, HERBERT L., Ensign, U. S. Naval Reserve Force.

TURNER, ROBERT T., Corporal, 52d Pioneer Infantry, U. S. Army, Camp Wadsworth, Spartanburg, S. C.

TUTTLE, W. B., Major, Construction Division, Quartermaster Corps, N. A.

NECROLOGY

EDWARD R. ARCHER

Edward R. Archer was born on March 9, 1834, at Old Point Comfort, Va. He received his early education in the private schools of Hampton and Richmond, Va., and at the age of 17 entered the employ of the Tredegar Iron Works of the latter city, where he served an apprenticeship of four years in the shops and drafting room of that company. On June 26, 1856, he was appointed third assistant engineer in the U. S. Navy and served in that capacity on the U. S. Frigates *Roanoke* and *Powhatan*, making a two and a half years' cruise around the world. At the close of the cruise he returned again to the Tredegar Iron Works and remained in their employ until the outbreak of the Civil War, when he entered the service of the Confederate Navy. When peace was declared he again reëntered the employ of the Tredegar Iron Works, and at the time of his death was chief engineer of the company.

In addition to being a member of our Society since 1890, Mr. Archer was one of the founders of the Virginia Mechanics Institute. He died at his residence in Richmond on March 13, 1918.

EDWARD CARRINGTON BATES

Edward C. Bates was born in Boston, Mass., in 1848. He was educated in the private schools of that city, preparatory to attending Brattleboro Academy, after which he went to the Massachusetts Institute of Technology where he was graduated with the first class sent forth, that of 1868.

He then began work in his chosen profession as civil and railroad engineer and on going West was active in the earliest days of the Union Pacific Railway. During his career he held the position of superintendent of works of the Union Electric Sign Signal Co., Boston, and the same later with the Union Switch & Signal Co., Pittsburgh. He was for five years superintendent with the Hall Typewriter Co. and for eleven years railroad representative for the Crosby Steam Gauge & Valve Co., Boston. He was also associated for a period with the Ewald Iron Co., St. Louis.

Mr. Bates was an inventor of note and his later years were devoted to inventing although in a less active way than formerly. He became a member of our Society in 1899. He died very suddenly on July 23.

CHARLES HARVEY HILE

Charles H. Hile was born at Bellefonte, Pa., in March 1864. He was graduated from Pennsylvania State College in 1892 with the degree B.S. and in 1893 he received the degree of M.E. from the University of Wisconsin.

He then entered the employ of the Philadelphia Traction Co., first as electrical assistant, then as engineer and inspector of underground conduit construction and later as operator in the power station. In July 1894 he entered the employ of the West End Street Railway Co., Boston, Mass., and served continuously with that company and its successor, the Boston Elevated Railway Co., for twenty-two years. During his long career with the two Boston companies, he won rapid promotions, being successively assistant superintendent of wires, superintendent of wires, assistant to the vice-president and chief of maintenance. In the last-named position he was in charge of the departments of mechanical and electrical engineering, maintenance of way, rolling stock and shops, building, stores, wires and conduits and power maintenance. Impairment of health finally required him to relinquish these heavy responsibilities and the company gave him an indefinite leave of absence with the privilege of engaging in lighter and less nerve-racking duties. In 1916 he became the secretary of the New England Street Railway Club, Boston, Mass. He was also editor of the publications of the club, *The Street Railway Bulletin* and the *Trolley Wayfinder*.

He became a member of our Society in 1916. He died on June 4.

HARRY C. HOLCK

Harry C. Holck was born in June 1887 in New York City. He received his technical education in the Carnegie Technical School, after which he entered the employ of the Keuffel & Esser Co., Hoboken, N. J., as assistant to the chief engineer. In 1908 he became connected with the George A. Ohl Co., Woodside, N. J., where he installed a drafting-room system and took charge of the design of their power presses and embossing machines. The following year he entered the employ of the Niles-Bement-Pond Co., Plainfield, N. J., as a designer, and while with this firm successfully designed a car-wheel lathe to turn car wheels at the rate of two in four minutes. In 1910 he became associated with the General Electric Co., Schenectady, N. Y., as engineer and designer of A. T. B. generators and synchronous and induction motors.

For the next three years he was employed successively by the Otis Elevator Co., New York City, as construction engineer for freight and passenger elevators; by the Regina Co., Rahway, N. J., as assistant to chief draftsman in systematizing and developing the design of a multi-process printing press; and by the Westinghouse Electric & Manufacturing Co., Pittsburgh, Pa., as engineer on control apparatus, rheostat, switchboards and oil switches. In 1913 Mr. Holck became connected with the Public Service Electric Co., Newark, N. J., where he was engaged in the design and engineering of sub-stations and central stations, system of railways and lighting distribution, and developed one of the largest and most modern stations in the East.

At the time of his death, June 13, he was employed as engineer and electric designer in the engineering department of the company. Mr. Holck became a junior member of the Society in 191[illegible].

JOHN DOLAN GABOURY

John D. Gaboury was born in Knoxville, Tenn., on June 3, 1879. Upon the completion of his collegiate education he took two years' special course in mathematics at St. Charles Barrome College, Sherbrooke, Quebec, Canada, and followed this in 1895 with a six months' special course in applied electricity at McGill University, Montreal.

Until about 1897 he was associated with his father who was one of the pioneer electric contractors and power-plant operators in the South. His next position was with the Greenville Light & Power Co., Greenville, Miss., as engineer, where he remained until 1905, holding successively the positions of electrician and superintendent. In 1905 he became connected with the Alabama City, Gadsden & Attalla Railway Light & Power Co., Attalla, Ala., as general manager and remained with them for a little over two years, during which time he designed and built a modern condensing steam-turbine power plant for lighting and railway service. In 1907 he entered the employ of the Woodward Iron Co., Woodward, Ala., as electrician, later becoming chief electrical engineer and finally superintendent of power, which position he had been holding for the last four years. The company makes approximately 1500 tons of pig iron per day, furnishing all of its own raw material. This involves the operation of several coal mines, red-ore mines, coal washers, by-product coke plants and a steam railroad for the transportation of raw material to the furnace plant. Mr. Gaboury was entirely responsible for the design, construction and operation of all the power-plant equipment, steam and electric hoists, haulage, rolling stock, steam and electric, as well as all of the repair work involved.

Mr. Gaboury became an associate-member of the Society in 1917 and was particularly active in the affairs of the Birmingham Section. He was also an associate-member of the American Institute of Electrical Engineers. He died very suddenly on May 17.

GEORGE E. WHITEHEAD

George E. Whitehead was born on September 6, 1846, at Ashton-under-Lyne, Lancashire, England. He was brought to this country when but a child and was educated in the public schools of Providence, later taking a special course in mathematics at the Jenks Morey School of that city.

During the period of the Civil War Mr. Whitehead was employed by the Burnside Rifle Works Co., leaving at the close of the war to serve his apprenticeship as mechanic with the Brown & Sharpe Manufacturing Co., Providence, R. I., at the same time completing his studies in algebra, geometry and trigonometry. He was next employed by the Household Sewing Machine Co., as tool maker and die cutter. In 1874 he became associated with the Rhode Island Tool Co. as assistant superintendent and later became superintendent, serving in that capacity for thirty-one years.

Mr. Whitehead became a member of the Society in 1887. He died on March 4, 1918.

LIBRARY NOTES AND BOOK REVIEWS

ARTICLES of interest from the Library of the four Founder Societies, selected list of accessions during the month, and reviews of books of special importance prepared by members of the A.S.M.E. and others particularly qualified.

BOOK NOTES

ELEMENTS OF FUEL OIL AND STEAM ENGINEERING: A Practical Treatise Dealing with Fuel Oil, for the Central Station Man, the Power Plant Operator, the Mechanical Engineer and the Student. By Robert Sibley, B. S., and Charles H. Delany, B. S., M. M. E., Members Am.Soc.M.E. Technical Publishing Company, San Francisco, 1918. First Edition. Cloth, 6 x 9 in., xiv + 320 pp., 127 illustrations, charts and figures. $3 net.

This book has as its underlying theme a study of fuel-oil power-plant operation and the use of evaporative tests in increasing the efficiency of oil-fired plants. The subject-matter has been treated in three main subdivisions: First, an exposition of the elementary laws of steam engineering; second, the processes involved in the utilization of fuel oil in the modern power plant; and third, the testing of boilers when oil-fired.

A new method has been used in treating the first subdivision, in that the viewpoint taken is that of the oil-fired instead of the coal-fired power-plant operator. This subdivision naturally requires the largest portion of the work.

The five chapters on Furnaces, Burner Classification, Gravity, Moisture Content, and Heating Value of Oils contain the gist of the information which will be of value to the inexperienced engineer whether he views the subject from a consulting or operating standpoint. The engineer who has had considerable experience in this line will be interested in the chapters on Suggestions for Fuel-Oil Tests and Their Tabulation, and the Use of Evaporative Tests in Increasing Efficiency of Oil-Fired Boilers, as these chapters, especially the latter, contain definite information worked out from practical experience in regard to furnace arrangement, oil burners, draft, flue-gas analysis and regulation.

The most interesting part to the experienced fuel-oil engineer is Appendix 2, which contains the report of conclusions in full of the Committee appointed by the Governor of California, in the latter part of 1917, to investigate the fuel-oil situation in that state and report their conclusions and recommendations. These conclusions cover utilization, production, consumption, storage, conservation and the remedy for the present shortage of oil in California. This is a remarkable report which should be read by every engineer interested in the future of fuel oil in this country.

We believe the authors have succeeded admirably in accomplishing the purposes which the book attempts to cover. It is unquestionably the best work of its kind for students of steam engineering who are interested in fuel oil. It is also of value to engineers, both consulting and operating, as it gives a large amount of information hitherto not covered by any work of this kind, and at the same time brings together much important matter which has appeared at various times in various forms. The subject-matter is clearly developed, and illustrated examples are worked out in great detail. The book is also profusely illustrated. To sum up, we believe this work occupies a field hitherto vacant in this particular branch of engineering.

B. R. T. COLLINS.

EDIBLE OILS AND FATS. By C. Ainsworth Mitchell. Longmans, Green and Co., New York, 1918. Cloth, 6 x 9 in., 159 pp. $2.

A concise outline of the chemical composition, and properties of the more important oils and fats, the methods of extracting them from the crude materials and of purifying and preparing them for food. Particular attention is given to the newer methods. A very full bibliography is appended to the text.

CONCRETE ENGINEERS' HANDBOOK. Data for the Design and Construction of Plain and Reinforced-Concrete Structures. By George A. Hool and Nathan C. Johnson, assisted by S. C. Hollister, with chapters by Harvey Whipple, Adelbert P. Mills, Walter S. Edge, A. G. Hillberg, and Leslie H. Allen. First edition. McGraw-Hill Book Co., Inc., New York, 1918. Flexible cloth. 6 x 9 in., 885 pp., illus., tables, diag. $5.

This work has been prepared to make available in concise form the best present knowledge concerning concrete and reinforced concrete, and to present complete data and details, as well as numerous tables and diagrams, for the design and construction of the principal types of concrete structures.

THE CYANIDE PROCESS. Its Control and Operation. By A. W. Fahrenwald. First edition. John Wiley and Sons, Inc., New York, 1918. Flexible cloth, 4 x 7 in., 256 pp., 37 illus., 1 folded pl., 1 folded chart, 27 tables. $2.

The object of the book is to furnish a laboratory guide, both for investigating a new ore and for conducting the laboratory of a mill, which will include the latest developments of the process and be sufficiently complete for ordinary needs.

DISEASES OF OCCUPATION AND VOCATIONAL HYGIENE. Edited by George M. Kober and William C. Hanson. P. Blackiston's Sons and Co., Philadelphia (copyright, 1916). Cloth, 6 x 10 in., 918 pp., 46 illus. $8.

With the assistance of a large number of experts, the editors have endeavored to present the basic facts concerning diseases of occupation in such a way as to form a safe, convenient guide for physicians, employers, workmen, legislators, public health officials and other interested persons.

ENGINEERING FOR MASONRY DAMS. By William Pitcher Creager. First edition. John Wiley and Sons, Inc., New York, 1917. Cloth, 6 x 9 in., 237 pp., 88 illus., 1 pl., 25 tables. $2.50.

Contents: Investigations and Surveys, The Choice of Type of Dam, Forces Acting on Dams, Requirements for Stability of Gravity Dams, General Equations for Design of Gravity Dams, The Design of Solid, Non-overflow Gravity Dams, The Design of Solid Spillway Gravity Dams, The Design of Hollow Dams, The Design of Arch Dams, Preparation and Protection of the Foundation, Flood Flows, Details and Accessories. Presents the theory and the fundamental assumptions of design of dams of this kind, and gives a number of examples showing the application of theory to practical designing.

GLOSSAIRE. (Anglais-Français) DES TERMES ET LOCUTIONS ELECTRO-TECHNIQUES LES PLUS USITES. Compilé par Aristide Filiatreault. M. J. Filiatreault, Montreal, 1913. Paper, 4 x 7 in., 59 pp.

A moderate priced English-French electrical dictionary of pocket size.

HOW TO SELL ELECTRICAL LABOR-SAVING APPLIANCES. One hundred and nineteen tested Plans for the Electric Store. Window Display. Show Cases, Shelves and Tables. Arrangement. Advertising. Prospects. Demonstrations. Training Clerks. Planning Sales. Management. Compiled by Electrical Merchandising. First edition. McGraw-Hill Book Co., Inc., New York, 1918. Cloth, 5 x 8 in., 115 pp., 15 illus., 13 pl. $1.

A manual for dealers in electrical supplies and fixtures,

suggesting methods for displaying stock, advertising, training clerks, etc.

INDUSTRIAL RECONSTRUCTION. A Symposium on the Situation after the War and How to Meet It. Edited by Huntley Carter. E. P. Dutton and Co., New York, 1918. Cloth, 5 x 7 in., 295 pp. $2.

Contains the results of an inquiry undertaken to ascertain the opinions held by a large number of distinguished English men and women as to the probable industrial situation in Great Britain after the war and the best policy to be pursued by Labor, Capital and the State. The views of statesmen, capitalists, labor leaders, economists and others are included.

INTERNATIONAL MINING LAW. By Theo. F. Van Wagenen. First edition. McGraw-Hill Co., Inc., 1918. Flexible cloth, 5 x 7 in., 342 pp. $3.50.

Starting with an account of ancient mining laws and customs, the author gives a digest of the present mining laws of the world. Statistics of production in the leading countries are given to show the effect of various laws on the industry, and there are discussions of different features of the laws. Confined to metal mining; the laws having to do with coal, iron and non-metals are omitted.

ORGANIC COMPOUNDS OF ARSENIC AND ANTIMONY. By Gilbert T. Morgan. Longmans, Green and Co., New York, 1918. Cloth, 6 x 9 in., 376 pp., $4.80.

This volume in Messrs. Longmans' series of Monographs on Industrial Chemistry discusses the methods of preparation and the chemical properties of those compounds which have a practical application or theoretical interest. A useful bibliography is included.

WAR ADJUSTMENTS IN RAILROAD REGULATIONS. Edited by C. H. Crennan. The American Academy of Political and Social Science, Philadelphia, 1918. (Annals of the American Academy of Political and Social Science, vol. 76. Whole number, 165. March, 1918.) Paper, 7 x 10 in., 333 pp., $1.

In this number of the Annals is presented a discussion, by a number of railroad men, political economists and lawyers, of various problems connected with railroad regulation.

The principal headings are: Railroad Regulation on Trial, War Pressure for Adequate Service, Present Effects of War Control of Railroads, Plans for Adjustment after the War, Continuing Problems of Public Policy, in addition to a chapter entitled Documents and Statistics Pertinent to Current Railroad Problems.

CANDIDATES FOR MEMBERSHIP

TO BE VOTED ON AFTER SEPTEMBER 21

BELOW is the list of candidates who have filed applications since the date of the last issue of THE JOURNAL. These are classified according to the grades for which their ages qualify them, and not with regard to professional qualifications, i.e., the ages of those under the first heading place them under either Member, Associate or Associate-Member, those in the next class under Associate or Associate-Member, those in the third class under Associate-Member or Junior, and those in the fourth under Junior grade only. Applications for change of grading are also posted. Total number of applications 198.

The Membership Committee, and in turn the Council, urge the members to scrutinize this list with care and advise the Secretary promptly of any objections to the candidates posted. All correspondence in this regard is strictly confidential. Unless objection is made to any of the candidates by Sept. 21, and provided satisfactory replies have been received from the required number of references, they will be balloted upon by the Council.

NOTE. The Council desires to impress upon applicants for membership that under the present national conditions the procedure of election of members may be slower than under normal conditions.

NEW APPLICATIONS

FOR CONSIDERATION AS MEMBER, ASSOCIATE OR ASSOCIATE-MEMBER

Alabama

BUBAR, HUDSON H., Mechanical Superintendent, Air Nitrates Corp., Muscle Shoals
KENT, J. F., Manager, American Cast Iron Pipe Co., Birmingham

Arizona

HOFF, EDWARD A., Construction Engineer, United Verde Copper Co., Clarkdale

California

TURNER, ALFRED J., Lubricating Oil Engineer, Standard Oil Co., San Francisco

Connecticut

ASHMUN, BERNARD I., Vice-Pres., Pratt & Cady Co., Hartford
CAREY, H. BISSELL, M. S. Little Mfg. Co., Hartford
LITTLE, MITCHELL S., Manufacturer, M. S. Little Mfg. Co., Hartford
MORHARDT, FRANK W., Mechanical Superintendent, Royal Typewriter Co., Inc., Hartford
PAINE, WALTER S., Safety Engineer, Aetna Life Insurance Co., Hartford
QUINN, LAWRENCE R., Captain, Ord. R. C., U. S. A., Scovill Mfg. Co. Waterbury
VANDE PLANCKE, GEORGE, Superintendent, Turner Machine Co., Danbury

Delaware

LINDSAY, WILLIAM J., Engineer, E. I. du Pont de Nemours & Co., Wilmington

District of Columbia

CHASE, ARTHUR H., Supervising Draftsman, U. S. Naval Gun Factory, Navy Yard
MARZOLF, JOSEPH M., Mechanical Expert, Aid Bureau of Yards & Docks, Navy Department

Florida

HAWKES, JOHN D., Construction Work, Buckman & Pritchard, Pablo Beach
KENNEDY, SIDNEY G., General Foreman, Atlantic Coast Line R. R. Co., Lakeland

Georgia

CLIFFORD, WALTER, General Supt., Atlantic Paper & Pulp Co., Savannah

Illinois

ADAMS, ERNEST H., Mechanical Engineer, Continental Can Co., Chicago
CHANDLER, ALBERT R., Captain, Ordnance Reserve Corps, Rock Island Arsenal
DRATZ, PAUL A., Chicago Representative, Whiting Foundry Equipment Co., Harvey
GALLUP, ROCKWELL L., Head of Engineering Dept., Torris Wold & Co., Chicago
KNAPP, CHARLES S., Assistant Chief Engineer, Pullman Co., Chicago
MILLER, EDWARD W., Chief Engineer, Fellows Gear Shaper Co., Springfield

Indiana

HUTCHCRAFT, D. I., Vice-Pres., Indiana Air Pump Co., Indianapolis

Kansas

SIMMERING, SIEBELT L., Assistant Professor, Steam and Gas Engineering, Kansas State Agricultural College, Manhattan

Maine

FOWLES, FRANK R., General Superintendent, York County Power Co., Biddeford

Maryland

WHITSITT, WILLIAM B., Chief Draftsman, Baltimore & Ohio R.R., Motive Pwr. Dept., Baltimore

Massachusetts

BANFIELD, FREDERICK E., JR., Superintendent, Saco-Lowell Shops, Newton Upper Falls
BATH, JOHN, Owner, John Bath & Co., Inc., Worcester
BINNS, FRANK, Draftsman, Hamblet Machine Co., Lawrence
DRAKE, ALDEN M., Chief Designer, Heald Machine Co., Worcester
EAMES, JESSE J., Instructor, M. E. Dept., Mass. Institute of Technology, Cambridge
KEEDY, DYKE V., Consulting and Metallurgical Engineer, Boston

KNIGHT, ARTHUR, Gage Design and Tolerance Engineer, Greenfield Tap & Die Corp., Springfield
LYLE, ERNEST T., New England Manager, Carrier Engineering Corp., Boston
ROOT, FRANCIS S., Power Engineer and Head of Pwr. Dept., Fall River Electric Light Co., Fall River
WITMER, ROY C., Secretary and General Manager, Blake Pump & Condenser Co., Fitchburg
ZSCHOKKE, ARTHUR J., Assistant Principal Draftsman, Watertown Arsenal, Watertown

Michigan

BAUS, RICHARD E., Assistant General Production Manager, Studebaker Corp., Detroit
BRITTSON, L. E., Major Ord. R. C., Inspector Ord., Ford Motor Car Co., Detroit
HARRIS, EMERY E., Vice-Pres., Pittelkow Heating & Engrg. Co., Detroit
HAWES, FRED W., Superintendent Wheel Dept., Detroit Pressed Steel Co., Detroit
LANE, HORACE H., Consulting and Designing Engineer, Detroit
McDONALD, William F., Heating Engineer, William F. McDonald Co., Detroit
PITTELKOW, ARTHUR G., President, Pittelkow Heating & Engrg. Co., Detroit

Missouri

FARNHAM, DWIGHT T., Consulting Industrial Engineer, St. Louis

Montana

PRUETT, GROVER C., City Engineer and Superintendent Water Works, Miles City

New Jersey

EPPENSTEIMER, WILLIAM F., Mechanical Engineer, United States Metals Refining Co., Chrome
FOX, AUBREY E., Industrial Engineer, Celluloid Co., Newark
McINTYRE, MALCOLM, Vice-Pres., Bergen Point Iron Works, Bayonne
MEIGS, WILLIAM P., Works Manager, Magor Car Corp., Passaic
RICHARDSON, HENRY, President, Richardson Scale Co., Passaic
SCHULHOFF, SAUL, Asst. Production Manager, Essex Rubber Co., Trenton
STENGER, JOHANNES G., Chief Draftsman, Marine Dept., Babcock & Wilcox Co., Bayonne
WOOD, HENRY E., Instructor of Special Mechanical Workers, Crocker-Wheeler Co., Ampere

New York

AXELSSON, GUSTAF S., Mechanical Engineer, Otis Elevator Co., New York
BLINN, EDWARD R., Superintendent of Construction and Maintenance, The Solvay Process Co., Syracuse
BRENNAN, JOHN E., Assistant Works Manager, The Remington Arms Union Metallic Cartridge Co., Inc., Ilion
CARMODY, JOHN P., Mechanical Engineer, Perin & Marshall, New York
CEBRAT, PAUL, Estimator and Purchasing Engineer, C. P. Perin & S. M. Marshall, New York
DISBROW, WILLIAM C., JR., Private Business, New York
ERB, EDMUND M., Manager, Merit Machine Mfg. Corp., New York
FLETCHER, HOWARD C., Chief Draftsman, Hull Div., Navy Yard, New York
GRIFFIN, GEORGE E., Mechanical Engineer, The Adder Machine Co., New York
GRUBER, MORRIS M., President and Engineer, Presto Machine Works, Brooklyn
HEIDELBAUGH, WILLIAM W., Secretary and Treasurer, Acme Cement Corp., Catskill
HOUGH, FREDERICK L., JR., Asst. Engineer, Edison Elec. Ill. Co., Brooklyn
McWILLIAMS, CLOYD C., Engineer of Machinery, American Loco. Co., Schenectady
MARSHALL, WALTER E., Buffalo Mgr., The Warner & Swasey Co., Buffalo
O'REILLY, PHILIP J., U. S. Inspector of Boilers, Steamboat Inspection Service, Custom House, New York
ROBLIN, WILMOT H., Inspector of Ordnance, U. S. Ord. Dept., Watervliet Arsenal, Watervliet
THOMAS, WILLIAM P., Chief Engineer, H. G. Vogel Co., New York
THOMPSON, CHARLES J., in charge Trench Warfare Section, Ord. Dept., New York
WHINERY, SAMUEL B., Sales Agent, Consulting Engineer, New York
WIBERG, HERBERT G., Chief Inspector, Compensation Inspection Ration Board, New York
WIDMER, JULES A., Designer, Confidential Experimental and Research Work, Sperry Gyroscope Co., Brooklyn

Ohio

BALBACH, EDWARD, Mechanical Engineer, James Leffel & Co., Springfield
BEAUMONT, JAY C., Chief Planner, Engrg. Dept., B. F. Goodrich Co., Akron
GREENE, OSCAR V., General Manager, The Cleveland Stoker & Mfg. Co., Cleveland
LOCKHART, JAMES, Chief Engineer, The Lakewood Engineering Co., Cleveland
WEAVER, ROBERT R., Chief Engineer, Ralston Steel Car Co., East Columbus

Oregon

GILL, JOSEPH W., Associate Engineer and Chief Draftsman, Smith & Watson Iron Wks., Portland

Pennsylvania

BENZON, GEORGE H., JR., Chief Draftsman, William Sellers & Co., Inc., Jenkintown
BRODHEAD, ELBER H., Vice-Pres., Parkesburg Iron Co., Parkesburg
ECHOFF, WALTER H., Assistant General Master Mechanic, Midvale Steel & Ordnance Co., Coatesville
FUNK, NEVIN E., Operating Engineer, Philadelphia Elec. Co., Philadelphia
GILLETT, MERRIMAN C., Branch Manager, Spencer Heater Co., Philadelphia
HUMPTON, JOHN R., General Superintendent of Skelp Mill, Parkesburg Iron Co., Parkesburg
KEAL, GEORGE I., Resident Engineer, U. S. Shipping Board, Hog Island, Philadelphia
LOWELL, DWIGHT E., Assistant Machinery Fabrication Engineer, American International Shipbuilding Corp., Hog Island
MORRISON, LACEY H., Production Officer, Instrument Dept., Frankford Arsenal, Philadelphia
PORTER, ROY H., Asst. Mechanical Engineer, New Jersey Zinc Co., Palmerton
WILSON, BENJAMIN W., Designer and Superintendent of Constr. of Mech. Equipment, Ballinger & Perrot, New York and Philadelphia

Rhode Island

ANDERSON, ALEXANDER W., Inspector of Boilers, Fidelity & Casualty Co., of N. Y., Providence

Tennessee

FRYANT, HARRIS T., Specialty Salesman, Crane Co., Memphis
WORDEN, ARTHUR F., Fire Protection Engineer, Dupont Engineering Co., Jacksonville

Texas

PALMER, WILLIAM R., Mechanical Engineer, Cananea Consolidated Copper Co., El Paso

Utah

REDWINE, LEWIS S., Chief Draftsman, American Smelting & Refining Co., Garfield

Virginia

WILLARD, JAMES A., Chief Draftsman, Du Pont de Nemours Co., City Point

Washington

WATTS, ROBERT L., Mechanical Superintendent, St. Paul & Tacoma Lumber Co., Tacoma

Wisconsin

DE VLIEG, RAY A., Chief Engineer, Kearney & Trecker Co., Milwaukee
HYLAND, PATRICK H., Assistant Professor of Mech. Engrg., University of Wisconsin, Madison
KNIGHT, CLARK M., Inspector, United States Indian Service, Ashland

FOREIGN

Australia

LEWIS, EDWARD P., Designing and Construction Engineer, Partner Kelly & Lewis, Melbourne
RIGBY, EDWARD J., Consulting Engineer, Private Practice and for Northern Territory Federal Government, Melbourne

Canada

DICKSON, GEORGE H., Official Gauge Checker, U. S. Army Ord. Corps, Civilian Dominion, Arsenal, Quebec
GILES, GEORGE, General Manager, Vancouver Engineering Works, Ltd., Vancouver
JANSEN, WALTER A., Operating Manager, Canadian Steel Foundries, Ltd., Montreal

Costa Rica

PICADO, RAMON M., City Engineer, Cartago City Council, Cartago

England

MARSHALL, WILLIAM J., Managing Director, Richard Garrett & Sons, Ltd., Engineers, Westminster

France

BANKS, SAMUEL J., Director, Works Manager, Berlut Automobile Works, Lyons

Hawaii

NELL, EDWARD J., Manager, H. S. Gray Co., Honolulu

Japan

SCHENCK, W. EGBERT, Treasurer and General Manager, The F. W. Horne Co., Tokyo

Porto Rico

STOREY, NORMAN C., Mechanical Superintendent, Aguine Sugar Co., Aguine

FOR CONSIDERATION AS ASSOCIATE OR ASSOCIATE-MEMBER

District of Columbia

HARTFORD, ERNEST, Office Manager, Committee on Education and Special Training, War Department. Washington

Massachusetts

LLEWELLYN, ERNEST R., Assistant Chief Draftsman, American Steel & Wire Co., Worcester

Michigan

DIX, HORACE P., Secretary and General Manager, Wilmarth & Morman Co., Grand Rapids

Ohio

DETWILER, HOMER H., General Manager, The Enterprise Co., Columbiana

New Jersey

JACKSON, LEONARD D., Consulting Ballistic and Mechanical Engineer, American Standard Metal Products Corp., Paulsboro

New York

BROWN, ARTHUR J., President and Treasurer, B. A. B. Model Mfg. Co., New York
MONAHAN, THOMAS G., Assistant to Chief Engineer, The Donner Steel Co., Inc., Buffalo

Oklahoma

EMMETT, CARL P., Superintendent, Bell Oil & Gas Co., Stone Bluff

Pennsylvania

EVANS, HERBERT H., District Sales Manager, Coatesville Boiler Wks. Philadelphia
STRICKLER, HARRY K., Asst. Chief Engineer, Erie Forge & Steel Co., Erie

FOR CONSIDERATION AS ASSOCIATE-MEMBER OR JUNIOR

California

SHIPLEY, JACK B., Marine Engineer, Moore Shipbuilding Co., Oakland

Connecticut

ROOT, FREDERICK J., Major O. R. C., Army Inspector of Ordnance and Acting Quartermaster, Marlin Rockwell Corp., New Haven

District of Columbia

KNIGHT, BERNARD O., Aeronautical Mechanical Engineer, Production Engr. Dept., Bureau of Aircraft Production, Washington

ROSS, ROBERT M., 1st Lieut., Ordnance Dept. N. A. Mechanical Engineer, U. S. Chemical Plant No. 4, Washington

Georgia

BROOKS, EUGENE A., Sales Engineer, The Babcock and Wilcox Co., Atlanta

Illinois

ACCOLA, EDWARD C., Methods Engineer, Western Electric Co., Chicago

HACH, CLARENCE A., Mechanical Engineer, Western Electric Co., Chicago

SCHEEL, CHARLES F., Department Head, Western Electric Co., Inc., Hawthorne

MANLEY, LLOYD M., Section Head, Western Electric Co., Chicago

Maryland

EVANS, BOYD V., 1st Lieut., Ordnance Department, U. S. A., Aberdeen Proving Ground

Massachusetts

SPENGLER, RALPH A., Captain, Watertown Arsenal, Watertown

Michigan

ALDRICH, HENRY E., JR., Chief Draftsman, The Wickes Boiler Co., Saginaw

Minnesota

ROTHENBERGER, JAMES H., Asst. Supt., Minneapolis Steel & Machinery Co., Minneapolis

New Jersey

HARBESON, JAMES P., JR., Plant Engineer, Camden Forge Co., Camden

HARDING, ARTHUR B., Construction Engineer, U. S. Cast Iron Pipe & Foundry Co., Burlington

LENNOX, WESTON, Leading Draftsman, Babcock & Wilcox Co., Bayonne

New York

ADAMSON, ALLAN A., Chief Draftsman, Boucher Cork & Machine Co., New York

BROWN, ANTHONY F., Vice-President & General Manager, B. A. B. Model Mfg. Co., New York

HARDY, CHARLES, General Manager, Blair Tool & Machine Wks., New York

NORRIS, DONALD G., Experimental Motor Div., Curtiss Aeroplane & Motor Corp., Buffalo

PIERCE, HAROLD F., Lieut., In charge mechanical development, Medical Research Laboratory, Field No. 1, Mineola, Long Island

WELLS, ALBERT W., Engineer, General Electric Co., Schenectady

Ohio

BENJAMIN, MERRIL G., Power Plant Engineer, Youngstown Sheet & Tube Co., Youngstown

Pennsylvania

BRYANT, ROBERT E., Captain, Ordnance R. C., Inspecting Artillery Ammunition, c/o Worthington Pump & Mach. Corp., Hazelton

ROTHERY, LUDWIG W., Erecting Engineer, Westinghouse Electric & Mfg. Co., Philadelphia

SOSS, HENRY, Captain Ordnance Dept., U. S. A., Worthington Pump Co., Hazelton

Virginia

KURTZ, WALTER W., Engineer, U. S. N. R. F., Supply Dept., Navy Yard, Norfolk

Canada

YARROW, NORMAN A., General Manager, Yarrows, Ltd., Victoria, British Columbia

FOR CONSIDERATION AS JUNIOR

Alabama

SNYDER, CLIFFORD L., 2nd Lieut., F. A. R. C., Nitrate Div. Ord. Dept., U. S. A., U. S. Nitrate Plant No. 1, Sheffield

Connecticut

COOK, FRED L., 2nd Lieut., Ordnance Reserve Corps, Scovill Mfg. Co., Waterbury

FLYNN, JAMES J., Asst., Chief Inspector of Ordnance U. S. Government, Remington Arms Bridgeport Wks., Bridgeport

HEALY, WILLIAM J., Laboratory Asst. in Mechanical Engineering, Sheffield Scientific School, Mason Laboratory of Mechanical Engineering, New Haven

District of Columbia

APPEL, SAUL C., Aeronautical Mechanical Engineer, Dept. of Military Aeronautics Supply Section, Buildings Grounds Branch, Washington

SMITH, BENJAMIN A., Technical Engineer, Bureau of Standards, Aero. Instrument Section, Washington

Georgia

SAUNDERS, WILLIAM H., Student, Georgia School of Technology, Atlanta

Illinois

HOGG, JOHN W., Corn Products Refining Co., Argo

HUTCHISON, FRED P., Efficiency Engineer, Western Electric Co., Inc., Chicago

Indiana

SACKSTEDER, ABNER F., Tool Designer & Checker, Nordyke & Marmon Co., Aviation Division, Indianapolis

Maryland

CRAWFORD, JOHN D., Chief Engineer, Maryland Pressed Steel Co., Hagerstown

MACOMBER, HENRY E., Technical Engineer at Power Plant No. 1, Edgewood Arsenal, Edgewood

Michigan

GUSTAVUS, CHARLES W., Engineer, Murphy Iron Works, Detroit

MERRITT, LEON F., Sr. Inspector of Airplanes & Airplane Engines, Aircraft Production Bureau, Detroit

SWENSON, CLARENCE Q., Asst. Engineer of Test, Ordnance Dept., U. S. A., Reo Motor Car Co., Lansing

New Jersey

MARSH, JOHN W., Designing Engineer, Calco Chemical Co., Bound Brook

New York

CUSTER, GARRY D., Lieut. Junior Grade, United States Navy, U. S. S. Montana, New York

FOSTER, JAMES F., Jr., Testing Materials, Curtiss Aeroplane & Motors Corp., Buffalo

HERRMANN, JOHN F., Mechanical Engineer, Herrmann & Grace Co., Brooklyn

JONES, WALTER H., 2nd Lieut. Ord. R. C., New York Air Brake Co., Watertown

NORMILE, THOMAS H. J., Ship Draftsman, Hull Division, Navy Dept., Brooklyn

Ohio

LINTON, DONALD S., Schedule Clerk, Ordnance Dept., Mosler Safe Co., Hamilton

Pennsylvania

BLACK, WILLIAM E., Shop Draftsman, Dravo Engineering Works, Neville Island

France

KERNS, ROY S., Assembling Locomotives, 19th Engineers (Railway) National U. S. Army, Co. A, American Expeditionary Forces

CHANGE OF GRADING

PROMOTION FROM ASSOCIATE

New York

BLUMGARDT, ISAAC E., Plant Engineer, Bayles Ship Yards, Port Jefferson, L. I.

PROMOTION FROM ASSOCIATE-MEMBER

Georgia

GREGG, ROBERT, Secretary, Atlantic Steel Company, Atlanta

Illinois

SILLCOX, LEWIS K., Mechanical Engineer, Illinois Central Railway, Chicago

New Jersey

BRUNNER, HANS, Production Manager, Essex Production Co., Trenton

Massachusetts

BURGESS, A. BRADLEY, Vice-President, Standard Plunger Elevator Co., Worcester

Michigan

HAYNES, EDWARD A., Second Vice-President, Pt. Huron Sul. & Paper Co., Port Huron

Texas

CRAWFORD, CHARLES C., Manager, A. M. Lockett & Co., Ltd., Houston

France

WOODS, SAMUEL H., Captain Q. M. C., U. S. A., Motor Transport Service, American Expeditionary Forces

PROMOTION FROM JUNIOR

California

BEATIE, CECIL E., Engineer, Shell Co. of California, San Francisco

Connecticut

BLACKMER, WALDO H., Works Service Manager, Electric Cable Co., Bridgeport

District of Columbia

SPICE, CHARLES G., Captain, Ord. R. C., Gun Division, Washington

Illinois

ROLLINS, L. E., Mechanical Engineer, Swift & Co., U. S. Yards, Chicago

Massachusetts

SCHWARZ, FRANS H., Master Mechanic and Mechanical Engineer for the Worsted Dept., Pacific Mills, Lawrence

New York

TEHLE, CHARLES J., Chief Draftsman, Marine Dept., Kerr Turbine Co., Wellsville

Ohio

SVENSEN, CARL L., Assistant Professor, Ohio State University, Columbus

Pennsylvania

MACLEAN, ARCHIBALD, JR., Purchasing Dept., Engineer, Westinghouse Elec. & Mfg. Co., Machine Works, E. Pittsburgh

SMITH, HOWARD W., Chief Engineer, Standard Engineering Co., Ellwood City

Texas

PALMER, GUERNSEY A., Manager and Resident Engineer, De La Vergne Engine Co., Houston

SUMMARY

New applications	198
Applications for change of grading:	
Promotion from Associate	1
Promotion from Associate-Member	7
Promotion from Junior	10
Total	216

PERSONALS

IN these columns are inserted items concerning members of the Society and their professional activities. Members are always interested in the doings of their fellow-members, and the Society welcomes notes from members and concerning members for insertion in this section. All communications of personal notes should be addressed to the Secretary, and items should be received by September 15 in order to appear in the October issue.

CHANGES OF POSITION

A. F. VAN DEINSE, formerly connected with the Federal Light and Traction Company, New York, has become associated with the Columbus, Delaware and Marion Electric Company, Marion, Ohio, as general manager.

EDWIN H. SEAMAN, until recently insurance engineer, American Lloyds, New York, has accepted the position of engineer with Johnson and Higgins, New York.

A. H. CHAS. DALLEY, formerly manager of the Chicago office of the American Engineering Company, of Philadelphia, Pa., has become affiliated with the Locomotive Superheater Company, Chicago, Ill., in the capacity of consulting engineer.

J. O. PERSONS has accepted the position of general manager of Bayles Shipyard, Port Jefferson, L. I., N. Y. He was until recently associated with the Remington Arms Company, Bridgeport, Conn., in the capacity of works engineer.

J. CARLTON WARD, JR., has become associated with the Pratt and Whitney Company, Hartford, Conn. He was formerly connected with the productive statistics division, Watervliet Arsenal, Watervliet, N. Y.

ROBERT N. FIELD has severed his connections with the United States Smelting, Refining and Mining Company, to take a position with the Western Sugar Refinery of San Francisco.

FREDERICK B. GARRAHAN, formerly with John Royle and Sons, Paterson, N. J., is now associated with the McGraw-Hill Publishing Company, New York.

JAMES G. RUSSELL, formerly instructor in mechanical engineering, Post Graduate Department, U. S. Naval Academy, Annapolis, Md., has accepted a position with Day and Zimmermann, Inc., Philadelphia, Pa.

JAMES D. TAYLOR has resigned his position of chief engineer and superintendent of the Twenty-third Street branch of the Y. M. C. A., to assume the duties of chief engineer and assistant superintendent of the Metropolitan Museum of Art, New York.

FRANK O. HOAGLAND, formerly affiliated with the Pratt and Whitney Company, of Hartford, Conn., has become associated with The Bilton Machine Tool Company, Bridgeport, Conn.

W. B. MOSES has severed his connection with A. Marx and Son, New Orleans, La., to accept a position with the Engineering Sales Company, Inc., of the same city.

SVERRE PETERSEN, until recently identified with the Lucey Manufacturing Corporation of Tennessee, Chattanooga, Tenn., in the capacity of chief engineer, has accepted the position of engineer with the Roxana Petroleum Company of Oklahoma, Tulsa, Okla.

ERNEST B. TALKES has resigned his position as master mechanic of the Federal Furnace Plant, By-Product Coke Corporation, South Chicago, Ill., to accept a similar position with the Inland Steel Company at Indiana Harbor, Ind.

L. W. HELMREICH has assumed the position of engineer, electricity, gas, heat and water department of the Public Service Commission of Missouri, Jefferson City, Mo. He was formerly head of the electrical department of the Ranken Mechanical School, St. Louis, Mo.

ALEX. B. MCKECHNIE has become affiliated with the G. M. Parks Company, Boston, Mass. He was formerly connected with the Merrill Process Company, of the same city, in the capacity of sales engineer.

WALLACE C. MILLS, until recently machine designer with Root and Van Dervoort Engineering Company, East Moline, Ill., has assumed similar duties with the Janesville Machine Company, Janesville, Wis.

GEORGE A. HICKERSON has resigned his position as engineer with McKesson and Robbins, Inc., New York, to accept the position of mechanical appraiser with Ford, Bacon and Davis, New York.

C. J. BEUST has entered the mechanical department, U. S. Nitrate Plant, Muscle Shoals, Sheffield, Ala. He was formerly connected with E. I. du Pont and Company, Wilmington, Del., in the capacity of engineering draftsman.

FREDERICK R. BANKS has resigned his position as assistant equipment engineer of the Remington Arms Union Metallic Cartridge Company, Inc., Bridgeport, Conn., to take a position as chief engineer with the McNab and Harlin Manufacturing Company, Paterson, N. J.

Z. E. SARGISSON has resigned his position as assistant works engineer for the Pan Motor Company, St. Cloud, Minn., to accept a position as an assistant maintenance engineer with the B. F. Goodrich Company, of Akron, Ohio.

GEORGE H. WATERS, formerly president of George H. Waters Company, Mariner Harbor, N. Y., has assumed the duties of president of the Raritan Dry Dock Company, Perth Amboy, N. J.

GEORGE H. SHARPE has resigned as chief engineer and director of Westcott and Mapes, Inc., New Haven, Conn., to accept the position of deputy administrative engineer for the State of Connecticut, U. S. Fuel Administration, Hartford, Conn.

ROBERT MAWSON, formerly associate editor of the *American Machinist* and recently connected with the firm of Mawson Brothers of Providence, R. I., has accepted the position of publicity manager with the Quigley Furnace Specialties Company, of New York.

JAMES G. ROSSMAN, until recently financial manager for William Hurd Hillyer, New York, is now manager of the banking department of Converse D. Marsh, New York.

ANNOUNCEMENTS

HERBERT A. BURNS has accepted a position with the New Home Sewing Machine Company, Orange, Mass., in the capacity of manager of the shell plant.

F. RODNEY PLEASONTON has become connected with the Savage Arms Corporation, as general works manager of its plants at Utica, Sharon and Philadelphia.

LIEUT. COL. P. P. WALKER, Engrs. U. S. A., is now stationed at Camp Cody and expects to leave shortly for France. Lieutenant Walker is Dean of the School of Engineering, University of Kansas, PROF. GEO. C. SHAAD taking his place during his absence.

R. L. ROWLEY, formerly with the Fire Marshal's Branch of the U. S. Shipping Board, Oakland, Cal., is now engineer for the Pacific division, in charge of fire protection in the shipyards, under the jurisdiction of the Shipping Board.

HENRY E. LONGWELL has assumed the position of chief engineer for the Pierce, Butler and Pierce Manufacturing Corporation, Eastwood, Onondaga Co., N. Y.

S. CARL SHIPLEY, of Minneapolis, Minn., has charge of the training of approximately 350 army men who will serve in the capacity of drivers of automobiles and trucks in war service.

JOHN V. MARTENIS, assistant professor of mechanical engineering at the University of Minnesota, Minneapolis, has undertaken the training of 300 enlisted men in the Navy who are to serve as machinist mates.

EDWARD B. GAY, JR., has accepted the position of hull fittings engineer with the American International Shipbuilding Corporation, Hog Island, Pa. Mr. Gay will, however, still maintain his consulting engineering office in Philadelphia, Pa.

PERCY BROWN has been promoted to the position of general superintendent of the record factories at Bridgeport, Conn., and Toronto, Canada, of the Columbia Graphophone Manufacturing Company.

By order of the County Court, Queens County, dated August 13, 1918, FREDERICK SUTERMEISTER'S name has been changed to FREDERICK ALDEN SPENCER.

APPOINTMENTS

HARRY K. FOX has been appointed mechanical engineer of the Chicago, Milwaukee and St. Paul Railway Company, Milwaukee, Wis., with headquarters at Chicago, Ill. He was formerly connected with the company in the capacity of engineer of tests.

EVERETT W. SWARTWOUT, formerly with the New York office of the Nordberg Manufacturing Company, has been appointed manager of the Philadelphia office, with the particular task of serving all the departments of the Emergency Fleet Corporation and various technical departments in Washington, as the company's shops are largely devoted to Government work.

OLIN H. LANDRETH, professor of civil engineering, Union College, Schenectady, N. Y., has been appointed to the Ordnance Department as mechanical engineer in the Production Bureau, and is to be stationed at Washington. To enable him to accept this appointment, the trustees of Union College have extended his leave of absence for another year.

HARRY HIMELBLAU has been appointed assistant to Joseph Harrington, the administrative engineer, U. S. Fuel Administration for Illinois.

CHARLES C. TRUMP, secretary and mechanical engineer of the Humphrey Gas Pump Company, Syracuse, N. Y., has accepted an appointment as assistant administrative engineer, under the Federal Fuel Administration for New York State and the Bureau of Conservation of the United States Fuel Administration, devoting his entire time to the work of fuel conservation in the State of New York.

EDWARD N. TRUMP is acting as administrative engineer under the Federal Fuel Conservation for New York State, with office in Syracuse, N. Y. Mr. Trump is serving as a volunteer, giving half of his time to this work.

WILLIAM G. EAGER, formerly vice-president of the Valdosta Lighting Company and consulting engineer for the General Utilities and Operating Company of Baltimore, Md., received his commission as lieutenant of the line (senior grade) United States Naval Reserve Force, and has been assigned to Philadelphia field work in that district.

EMPLOYMENT BULLETIN

THE SECRETARY considers it a special obligation and pleasant duty to make the office of the Society the medium for assisting members to secure positions, by putting them in touch with special opportunities for which their training and experience qualify them, and for helping any one desiring engineering services. The Society acts only as a clearing house in these matters.

GOVERNMENT POSITIONS

Stamps should be inclosed for transmittal of applications to advertisers; non-members should accompany applications with a letter of reference or introduction from a member; such reference letter will be filed with the Society records.

CONSTRUCTION MEN on coke-oven plants. Men competent to follow out plans and details of construction and plant layout. Experience in chemical and gas plants serviceable 0525.

ENGINEERS with experience in machine shops, and men of general engineering experience needed. 0549.

HIGH-GRADE TECHNICALLY-TRAINED MEN, preferably graduates of a mechanical or electrical engineering course. Those with some practical experience in testing or designing machinery preferred. 0552.

COMBUSTION ENGINEER wanted by the Bureau of Oil Conservation, Oil Division, U. S. Fuel Administration, for each of the following districts, to act as inspector, visiting all plants within his district using fuel oil and natural gas: Boston, Providence, New York City, Philadelphia, Pittsburgh, Buffalo, Detroit, Chicago, Minneapolis, Tulsa, New Orleans, and San Francisco.

It is desirable to have these men act as volunteers where possible, but the Administration is prepared to pay a reasonable compension for men who cannot afford to give their services to the Government. Only men who have had experience in fuel-oil and natural gas combustion would be of value. 0568.

MECHANICAL, Civil, Electrical and Marine Engineers are required for shipyards, principally on Atlantic Coast. Work to be the designing and construction of hulls and ship equipment. 0597.

YOUNG MEN wanted for the Department of Military Aeronautics. Should have mechanical training, and if possible, be thoroughly grounded in electrical work. May be of draft age and will go as enlisted men, then assigned to Training School for Radio Mechanics and after instruction will be sent overseas. They will be inducted at once. Schools conducted in Pittsburgh and New York City.

CIVILIAN POSITIONS

SUPERINTENDENT for projectile shop. Must be able to handle men intelligently, have had actual experience in the forging and machining of shells, be thoroughly experienced in production work, and possess executive ability. Location Connecticut. I-0523.

YOUNG SALES ENGINEER for leading firm of power-plant specialty manufacturers. Man with experience in power-plant equipment wanted; technical graduate preferred. Excellent prospects. Location Philadelphia. I-0524.

ESTIMATOR-DRAFTSMAN, who can read blueprints, do the necessary laying out and pick off quantities. Work is all in sheet and plate steel, tanks and boilers, and special apparatus. Location Jersey City. I-0526.

YOUNG ENGINEER (draft-exempt) to assist in supervising operation of private power plants and in engineering new industrial plants. Salary according to results. Location New York. I-0528.

TWO COLLEGE GRADUATES for drafting room with a few years' experience in detailing and drafting in connection with the layout of furnace work, elevator and conveyor machinery, boiler-plant work, etc. Men required to make stress diagrams and estimates of the various structures which they design, and take off quantity estimates. I-0531.

DRAFTSMAN, experienced and competent man to take care of general layouts such as are made in case a new proposition has to be lined up in the drafting room for estimating purposes or for the purpose of general arrangement and best utilization of available ground area. Man wanted who is well acquainted with the handling of material in large quantities by mechanical appliances and who has preferably had experience in the same line of work at metallurgical plants. I-0532.

EXPERIENCED CHECKER who can check up all drawings before they leave the drafting room as regards detail dimensions, and also go over the stress diagrams and the general design of buildings and various structures so that the checking will be complete and not have reference only to detail dimensions. I-0533.

EDITOR with special knowledge in marine engineering and boiler manufacture. Headquarters New York. I-0534.

ASSISTANT MASTER MECHANIC or MECHANICAL ENGINEER. Mechanical graduate or man with at least three years' college education and some practical experience in machine-shop work or factory maintenance. Work consists principally in the maintenance and operation of hydraulic pumps, presses, and similar lines. To start in office as a clerk and cost accountant at $100 per month. Progress and promotion will depend entirely upon the man himself. Location Canada. I-0536.

ORGANIZING ENGINEER for large plants operating 30,000 to 40,000 hp. of boilers, large electrical units, also refrigeration machinery, evaporators, stills, gas machinery, and varied mechanical equipment. Young man who has had technical training and experience and is qualified to guide in mechanical development. Location Ohio. Salary depends on man. I-0542.

DESIGNER for semi-Diesel or hot-bulb heavy-oil engines to be used for marine and land purposes—one who has had experience on this type of machinery. State requirements, salary, etc. Location New York. I-0543.

MECHANICAL, CIVIL or AERONAUTICAL ENGINEER capable of handling mathematical work connected with the design of aeroplanes. Men with mathematical experience in other lines will be considered. Position is with aircraft factory on Long Island. I-0556.

ASSISTANT TO DIRECTOR of large university engineering-experiment station, to have some teaching requirements; duties to include all editorial work connected with publication and distribution of bulletins, requiring some practical editorial experience. Initiative and ability to carry out work with minimum supervision on the part of head of the department. Salary will depend largely upon age, experience, and training of man. I-0558.

YOUNG ENGINEER with some experience in assembling small parts such as time and percussion fuses will be afforded excellent opportunity to show worth as the head of fuse department of a large ammunition company. Salary commensurate with experience and demonstrated ability. Location Connecticut. I-0562.

SUPERINTENDING MECHANICAL ENGINEER AND FOREMAN for tin-smelting plant. Men familiar with tin-ore products and manufacturing. Location Brooklyn. I-0563.

SUPERINTENDENT OF CONSTRUCTION for plant manufacturing conveying machinery. Desire executive type of man both from office and shop standpoint. Salary depends on man. Location New York. I-0564.

FACTORY SUPERINTENDENT. Manufacturer of steel tanks desires to communicate with technical graduate, married man or one with dependents, who has had shop experience, knows up-to-date production methods, labor problems, and familiar with general cost accounting. In reply state experience and education. Salary to start $3000. Location Massachusetts. I-0566.

COMBUSTION ENGINEER to do commercial engineering work. Experience with mechanical stokers. Good position for one desiring to prepare for sales work. Location Pittsburgh, Pa. I-0567.

ENGINEERING SOCIETY requires man of judgment, experience, executive ability and personality, to develop standardization work. Position involves coördinating work of several important committees of manufacturers and users in mechanical engineering lines. State full qualifications and salary. I-0569.

MECHANICAL ENGINEER along general lines of factory reorganization, together with some mechanical drafting. Salary to start $2500. Location Connecticut. I-0571.

SALES ENGINEER, between 25 and 32, draft-exempt or in class 4. Must be energetic, have initiative and be a thinker. Man wanted with engineering-college degree and one year's shop experience on machine design, or high-school education and two or three years' work on machine design. Salary $1800, with excellent opportunity for advancement. To travel; New York headquarters. I-0572.

DRAFTSMAN, preferably one with experience in hydraulic-turbine work. Permanent position and good opportunity for high-grade man only. Give full particulars in first letter. Location Ohio. I-0573.

HEAD OF SCHOOL FOR BOYS in Detroit. Man experienced in the charge of boys' school covering the grades in the grammar and high-school. Chief requisite, personality. Salary $1500. I-0574.

DRAFTSMAN on plant layout work of factory buildings. Concern engaged in the manufacture of steel barrels, tanks, oil pumps and portable furnaces for hardening and tempering steel. Location Massachusetts. I-0575.

SUPERINTENDENT for factory employing about 200 men. Established business. Good opening for right man. Must be thoroughly experienced in general manufacturing, estimating and in the handling of men. Location New Jersey. I-0576.

YOUNG MAN with some experience in drawing for preparation of wiring diagrams for motor-controller circuits. $15 to $25 per week, according to ability. Employment continuous until drafted into Government service, or, if exempt, can offer permanent position. Location New York. I-0578.

SUPERINTENDENT for Barrel Manufacturing Division. Must be familiar with making of barrels of light-gage steel; girths are seam welded and heads are lock seamed; experience on oxy-acetylene is also essential.

Splendid opportunity for high-class man. Location Massachusetts. I-0579.

CHEMISTS OR ENGINEERS wanted by firm engaged in coal-tar distillation and roofing manufacture. Work will be of an experimental nature in connection with new processes of manufacture and new use for products. Location New York. I-0580.

CHIEF DRAFTSMAN AND GENERAL ASSISTANT to chief engineer. Progressive paper and pulp manufacture. Concern in Canada offers excellent opportunity to capable man preferably with paper-mill experience. I-0581.

TECHNICAL TRAINED YOUNG MAN with several years practical work wanted for position in publicity department of large manufacturer doing world business. Should be in Class 4 draft. Splendid opportunity for capable man in sales work. Advertising experience not necessary. Location Ohio. I-0582.

ENGINEERING OR ARCHITECTURAL DRAFTSMAN capable of doing good work, at least high-school education. Work will be largely drafting in office of consulting engineer and includes acting as assistant to engineer on tests in power plants, etc. Some inspection of construction work. Salary $25 per week. Location New York. I-0583.

ENGINEERS capable of handling responsible position in newly-organized production department of Detroit automobile company, engaged on war orders. Salary $40 to $50 per week. I-0584.

INSTRUCTOR in mechanical drawing and machine design for day technical school and evening classes. Salary $2000. I-0585.

TECHNICAL GRADUATE of about 28 years of age, with some experience in installing office and shop systems; physically unfit for military service, or placed in limited service. Man with initiative and ability to get results is preferred, even if no previous experience in the work above named. Location Massachusetts. I-0586.

TWO MANAGERS manufacturing department and procurement of equipment for expanding cartridge department Illinois. Position of works manager covers manufacturing of cartridges in general way. Can use a factory manager with ability in manufacturing complicated and technical line of goods. I-0587.

EFFICIENCY ENGINEER. Experienced man with technical training for testing and efficiency work in steam-electric plant near New York. Man with initiative who can recommend and carry out improvements. Tact requisite. State age, education, experience, references and salary expected. I-0588.

ASSISTANT EFFICIENCY ENGINEER. Young technical man with one or two years' power-plant experience as assistant to efficiency engineer. Opportunity for broad experience and advancement; location near New York. State age, education, experience, references and salary expected. I-0589.

WORKS MANAGER for plant located in Southern Ohio, manufacturing line of pumps, compressors, heaters, cotton-seed material, machinery and the like. The plant comprises foundry, pattern shop, machine shop, etc. At present is engaged in the assembling of six-ton tractors. Man capable of earning from $6000 to $8000 per year to start. Should be familiar with modern duplicate-parts manufacture, modern shop and foundry administration, cost accounting, stores keeping and kindred allied subjects; capable of developing into general manager. I-0590.

BUYER of fabricated parts for aviation motors. Work would be under control of outside manufacturing department; qualifications extraordinary, and differ decidedly from those required of the ordinary buyer or purchasing agent. Man with considerable buying experience on fabricated parts, with concern which has been assembling automobiles from purchased parts, or similar buying experience along gas-engine lines. Shop experience and familiarity with machine tools. Proposition concerns one of furnishing tools and materials to the vendor, specifying just how the parts are to be made. American citizen, 35 to 45 years old, capable of earning from $4500 per year up. Position must be filled immediately. Location New York. I-0591.

PLANNING DEPARTMENT POSITION consists of laying out the work for the different departments and following ti all through the different departments to see that it is pushed through the factory in shortest possible time. Working on 92% to 96% Government Work. Location Philadelphia. I-0592.

MEN WITH TECHNICAL TRAINING IN MECHANICAL ENGINEERING wanted by manufacturer of recording meters and power plant equipment; opening for several men in engineering department. Some power-plant experience. Position offers good inducements, experience and future often leading to permanent positions in efficiency work in large power plants. I-0593.

SUPERINTENDENT, mechanical installation, familiar with plumbing, heating and lighting, electric line work and house wiring. Salary $3600 to $5000. I-0599.

YOUNG MEN available for department of mechanical engineering of large Middle West University to replace men called into Government service. I-600.

MEN AVAILABLE

Only members of the Society are listed in the published notices in this section. Copy for notices should be on hand by the 12th of the month, and the form of notice should be such that the initial words indicate the classification. Notices are not repeated in consecutive issues.

MECHANICAL ENGINEER, age 35, thirteen years' experience, covering design, construction and maintenance of industrial works. Capable of acting as assistant chief engineer, master mechanic or superintendent of steel rolling mill on any maintenance proposition. Thoroughly conversant with technical and practical side of steam, pneumatic and hydraulic work. Also familiar with electrical apparatus. Prefers location near New York, Philadelphia or Baltimore. I-222

EXECUTIVE, member, 49, practical workman, technical education, wide experience in manufacturing, covering shop, sales, design, office, finance, management. Large experience in the forging business. I-223.

GENERAL OR WORKS MANAGER, American, age 47, practical mechanic and designer; executive and sales experience; designed and placed on market well-known line automatic machinery. Successful in handling skilled labor. Working knowledge of general and cost accounting systems, etc. At liberty about September 1st. Position in which an interest in business could be obtained preferred. Salary $5000. I-224.

MEMBER with broad business and engineering experience here and abroad, American, 45; fully conversant with the principal languages; knowledge of purchasing and selling; tactful in handling of men; at present employed as designer of special plant. Desires change preferably to supervise work, inspect or represent, or act as assistant to executive where responsibility is required. To start, $4000. I-225.

COMPETENT FOUNDRY MAN capable of handling any foundry proposition, having charge of some of the largest and most up-to-date foundries in the country. I-226.

MANAGER, EXECUTIVE, ORGANIZER. Chemical engineer, technical graduate, not subject to draft. Twenty years' experience conduct of large industries. Fine record in designing and construction. Ample reference. I-227.

MECHANICAL AND REFRIGERATING ENGINEER, member, thoroughly experienced in refrigerating and general engineering and design of all kinds of machinery power plants, refrigerating and ice-making plants; competent to take charge of office force, supervise erection and handle tactfully executives and men; exemplary habits. I-228.

MECHANICAL ENGINEER, member, technical graduate, 38; long experience in heavy, light and multiple manufacture, experimental and development work. At present chief draftsman on elevating and conveying machinery. Relations with subordinates and co-workers invariably pleasant and successful. Desires new permanent position in engineering executive line, with increased scope and responsibilities. I-229.

MECHANICAL ENGINEER, associate member, age 32, married. Now employed as mechanical engineer of plant making large number of interchangeable brass and light gray iron parts. Eleven years tool designing, testing and general engineering and manufacturing. Desires location in Southern New England. I-230.

CHIEF OPERATING ENGINEER, associate, 40 years of age, with 15 years' experience, desires situation with progressive concern. Nine years' satisfactory service as chief engineer. Experience covers steam, electric and producer gas; Diesel engines and refrigeration. I-231.

WORKS MANAGER, broad practical experience in design and interchangeable quantity production of small high-grade apparatus, such as registers, adding, coin-counting machines and fuses. Can organize new plants intending to engage in above lines. Have been successful in the handling and training of help and securing maximum results from equipment. Fully acquainted with factory systems. Employed at present. Only high-grade connection will be considered. I-232.

MANAGER now successfully conducting Philadelphia office for large concern manufacturing electrical, mechanical and pneumatic equipment desirous of making change; has acquired unusual business and technical training during 8 years of continuous service with present company. Thoroughly experienced in sales, engineering and construction; handling these departments now in territory comprising five Middle Atlantic States. Young man, married, with excellent references. Salary approximately $4500. I-233.

PURCHASING EXECUTIVE, also qualified as supervisory-office and plant engineer. Acquainted with largest manufacturers of mechanical and electrical equipment and suppliers of engineering materials. At present engaged along these lines, wishes connection with opportunity for greater activity. I-234.

SALES ENGINEER, mechanical-electrical, technically trained; American, 35 years of age, married; speaks Spanish and Portuguese, acquainted with machine tools, construction machinery, mechanical-electrical equipment, sugar machinery, 13 years' sales experience; executive ability, desires to connect with manufacturer as sales engineer for South America. I-235.

SALES ENGINEER with Latin-American experience, speaking Spanish, wishes to make connection for representation in Latin-American countries or Spain. Special qualifications for successful representation in railway supplies, power-plant equipment, etc Thoroughly versed in foreign trade methods. Mechanical engineer, fourth class in draft. I-236.

EXECUTIVE, experienced buyer and publicity man; M. E. graduate, located in New York City, will execute commissions for out-of-town concerns, and can devote portion of each day to outside interests. Address care of The Journal. I-237.

ACCESSIONS TO THE LIBRARY

AEROPRINTS. Blue prints with technical descriptions: No. 3, L. W. F. Tractor Biplane; No. 5, L. V. G. Tractor Biplane; No. 6, Wright Light Scout; No. 7, London and Provincial Tractor; No. 8, Aeromarine Hydrobiplane; No. 9, Standard Twin-Motor Biplane; No. 10, United Eastern Tractor Biplane; No. 11, Lawson Tractor Biplane; No. 12, Friedrichshaten Biplane; No. 23, Curtiss 3-wheel exhibition pusher biplane; No. 30, Nieuport Scout. *New York, 1916-18.* Purchase.

AMERICAN WIRE ROPE. Catalogue and Handbook. *1913.* Gift of American Steel & Wire Company.

AN APPRÉCIATION OF TWO GREAT WORKERS IN HYDRAULICS. Giovanni Battista Venturi, born 1746; Clemens Herschel, born 1842. By Walter G. Kent. *London, 1912.* Gift of Clemens Herschel.

L'ARMÉE ALLEMANDE A LOUVAIN EN AOUT 1914 ET LE LIVRE BLANC ALLEMAND DU 10 MAI 1915. DEUX MEMORIES. *Port Villez, 1917.* Gift of Prof. O. Steels.

THE ATHENAEUM. Subject Index to Periodicals, 1916. Science and Technology, including Hygiene and Sport. *London, 1918.* Purchase.

LA BELGIQUE ET L'ALLEMAGNE. Textes et documents précédés d'un avertissement au lecteur par Henri Davignon. *n. p., 1915.* Gift of Prof. O. Steels.

BIG CREEK INITIAL DEVELOPMENT, PACIFIC LIGHT AND POWER CORPORATION. *1914.*

BOILER FURNACE OPERATION. Science and Common Sense. By Lester Budd. *Philadelphia, n. d.*

CANADA. Munition Resources Commission. Report of the work of the Commission, Nov. 1915-Feb. 1918. First. *Ottawa, 1918.* Gift of Commission.

CLEARING LAND OF ROCKS FOR AGRICULTURAL AND OTHER PURPOSES. By J. R. Mattern. *New York, 1918.* Gift of Institute of Makers of Explosives.

CLEARING LAND OF STUMPS. *New York, 1917.* Gift of Institute of Makers of Explosives.

COLORADO SCIENTIFIC SOCIETY. Year Book, 1882-1916. *Denver, 1916.* Gift of Society.

COMMERCIAL CREDITS THROUGH ACCEPTANCE. Address by Albert Breton. *New York, 1918.* Gift of Guaranty Trust Company.

CONCRETE CONSTRUCTION. June 1918, prepared by Portland Cement Association. Gift of Association.

COURS DE MÉCANIQUE. vols. 1-4. By L. Guillot. *Paris, 1911, 1913, 1918.* Purchase.

DIGEST OF THE FEDERAL RESERVE ACT, including amendments to June 21, 1917. *New York, 1917.* Gift of Guaranty Trust Company.

DISEASE IN MILK. The remedy Pasteurization. The life work of Nathan Straus. Ed. 2. *New York, 1917.* Gift of Mrs. Lina Gutherz Straus.

ELECTRICAL WIRES AND CABLES. Catalogue and Handbook. *1910.* Gift of American Steel & Wire Company.

ELECTRIFICATION OF RAILROADS AS A WAR MEASURE. *East Pittsburgh, 1918.* Gift of Westinghouse Electric & Manufacturing Co.

ESSAYS OF CLEMENS HERSCHEL. Gift of Clemens Herschel.

EXTRACTING NITROGEN FROM THE ATMOSPHERE AT A POWER COST OF OVER 221 TONS PER DAY FOR A 1000 KILOWATT POWER PLANT (equivalent to over 5,950,000 cu. ft. of Nitrogen gas), or 248 cu. ft. for one kilowat hour. Edition 5. By J. F. Place. *Glenridge, N. J., 1918.* Gift of author.

FEDERAL ESTATE TAX LAW AND REGULATIONS. Act of Sept. 8, 1916, amended March 3, 1917. *New York, 1917.* Gift of Guaranty Trust Company.

INDUSTRIAL HEATING AS A CENTRAL STATION LOAD. Parts 1-2. *New York, 1917.* Gift of D. D. Miller.

MOODY'S MANUAL OF RAILROADS, 1918—Public Utilities Section. *New York, 1918.* Purchase.

——— Complete list of securities maturing July 1, 1918, to June 30, 1920. Vol. VI. *New York, n. d.* Gift of Moody Manual Co.

NEW JERSEY. Department of Conservation and Development. Annual Report, 1917. *Union Hill, N. J., 1918.* Gift of Department.

NEW SOUTH WALES. Water Conservation and Irrigation Commission. Report, 1917. *Sydney, 1918.* Gift of Commission.

NEW YORK CITY. Board of Water Supply. Contract drawings for the construction of portions of the Peekskill division of the Catskill Aqueduct between Hunter's Brook and Foundry Brook Valleys. (Contract No. 2.)

——— Contract drawings for the construction of a portion of the Esopus Division of the Catskill Aqueduct in the towns of Olive and Marbletown, Ulster Co., N. Y., 1908. (Contract No. 11.)

——— Contract drawings for the construction of Hunter's Brook and Scribner Tunnels and portions of Yorktown cut and cover in the Croton Division of the Catskill Aqueduct in the town of Yorktown, Westchester Co., N. Y., 1908. (Contract No. 23, with specifications.)

THE PROMISE OF OUR VISION. Address by Francis H. Sisson. *New York, 1918.* Gift of Guaranty Trust Company of New York.

PUBLIC UTILITIES REPORTS ANNOTATED. 1918-A. *Rochester, 1918.* Purchase.

——— Professional reference list. 1918 issue. *Rochester, 1918.* Purchase.

A RECORD THAT IS A PROMISE. An account of the changes wrought by the war in the financial and industrial structure of Canada. *New York, 1918.* Gift of Guaranty Trust Company of New York.

RED CROSS INSTITUTE FOR CRIPPLES AND DISABLED MEN. Placement Technique in the employment work of the Institute. By Gertrude R. Stein. (Publications, Series I, no. 9.)

——— Relation of the short, intensive industrial survey to the problem of soldier reeducation. By G. A. Boate. (Publications, Series I, no. 10.)

——— Training in English Technical Schools for disabled soldiers. By John C. Faries. (Publications, Series I, no. 8.)

——— Vocational School for disabled soldiers at Rouen, France. By J. Breuil. (Publications, Series I, no. 11.)

SAFE-GUARDING THE HOME AGAINST FIRE. A fire prevention manual for the school children of America. Prepared for the United States Bureau of Education by the National Board of Fire Underwriters.

A SHADE TREE GUIDE. By Alfred Gaskill. *Union Hill, N. J., 1918.* Gift of New Jersey. Department of Conservation and Development.

SPEEDING UP—AMMUNITION AND MUNITION PRODUCTION. "Gravity."

STATISTICAL ABSTRACT OF THE UNITED STATES. 1917. *Washington, 1918.* Gift of U. S. Department of Commerce. Bureau of Foreign and Domestic Commerce.

STATISTICS OF EXPRESS COMPANIES. Annual Report. 7th. *Washington, 1918.* Gift of Interstate Commerce Commission.

TEACHING OF SAFETY IN TECHNICAL SCHOOLS AND UNIVERSITIES. A memorandum prepared for the aid of those desiring to undertake such work. National Safety Council, June, 1918. Gift of National Workmen's Compensation Service Bureau.

USE OF EXPLOSIVES IN MAKING DITCHES. *New York, 1917.* Gift of Institute of Makers of Explosives.

USE OF EXPLOSIVES IN THE TILLAGE OF TREES. *New York, 1918.* Gift of Institute of Makers of Explosives.

TRADE CATALOGUES

AERO PULVERIZER COMPANY. New York, N. Y.
Bulletin No. 26. Pulverized fuel combustion.

CENTRAL SCIENTIFIC COMPANY. Chicago, Ill.
Bulletin No. 15. A new analytical balance.
Bulletin No. 17. American made glassware and porcelain for American laboratories. Whatman filter paper. 1917.
——— No. 19. Cenco laboratory rheostats rated for continuous duty. 1918.
——— No. 20. Balances and weights. 1917.
——— No. 36. Matthews gas machine.
——— No. 45. Cenco-Nelson high-vacuum pumps. 1918.
——— No. 50. A new single-walled drying oven. 1918.
——— No. 61. A new DeKhotinsky drying oven. 1918.
——— No. 70. Cenco Polar water stills. 1918.

DEVINE, J. P., COMPANY. Buffalo, N. Y.
Bulletin 105A. Devine apparatus for the color, chemical, dyestuff and allied industries.

DE LAVAL STEAM TURBINE COMPANY. Trenton, N. J.
Bulletin N. Centrifugal boiler-feed pumps. 1918.

DELTA STAR ELECTRIC COMPANY. Chicago, Ill.
Bulletin No. 33. High-tension indoor equipment.

ERIE SPECIALTY COMPANY. New York, N. Y.
Erie standard aircraft metal parts. Descriptive booklet.

GENERAL ELECTRIC COMPANY. Schenectady, N. Y.
Bulletin No. 41302A. Polyphase induction motors. 1918.
——— 47070. Direct-current standard-unit panels 90 in. high, 125 and 250 volts 2-wire, and 125-250 volts 3-wire for general power and lighting service.
Class 317 (68202) CR 3100 drum-type controllers for series, etc.

INVINCIBLE VACUUM CLEANER MANUFACTURING COMPANY. Canal Dover, Ohio.
Descriptive booklet of "The Invincible."

IVANHOE-REGENT WORKS OF GENERAL ELECTRIC CO. Cleveland, Ohio.
Catalogue No. 260. Regent bowls and shades with Rozelle color decorations. 1918.
Price list for Catalogue No. 257.

LINK-BELT COMPANY. Philadelphia, Chicago, Indianapolis.
Book No. 312. Link-Belt silent chain the efficient drive for machine tools. 1918.

LUDLUM STEEL COMPANY. Watervliet, N. Y.
Descriptive catalogue of carbon and alloy tool steels, high-speed steel.

PARKS, THE G. M., COMPANY. Fitchburg, Mass.
The Turbo-humidifier, being a simple practical device for producing artificial humidity, using an old principle in a new way. 1918.

SCHRAMM, CHRIS. D., & SON, INC. Philadelphia, Pa. Catalogue No. 18. The Schramm Line.

SHAIN, CHAS. D. Brooklyn, N. Y.
Circular No. 57. Shain copper terminals.

STURTEVANT, B. F., COMPANY. Hyde Park, Mass.
Catalogue No. 150. Fuel economizers and air heaters.
——— No. 234. Steel-plate blowers and exhausters.

L. SOUNEBORN SONS, INC.
Lapidolith for all concrete floors. Descriptive booklet.

WHEELER CONDENSER & ENGINEERING CO. Carteret, N. J.
Bulletin No. 109-B. Wheeler-Balcke Cooling towers. 1918.
Bulletin describing The Lillie Evaporator for Waste Waters.

SELECTED TITLES OF ENGINEERING ARTICLES

THE section Selected Titles of Engineering Articles appears in this issue on an enlarged scale.

This development is essentially a war activity. As a result of the war, engineers are constantly confronted with new problems and in consequence of the reconstruction period to follow, this condition will undoubtedly continue to exist for a long time to come.

One of the greatest services which the Society can render at this critical period is to place at the disposal of engineers, as a basis for their work, the means for using the wealth of data and general information published from month to month in the world's technical press. For this to be of any considerable value to the engineer, he must know, first, what information has appeared, and second, where it is to be found. To supply this knowledge in concise and convenient form is the purpose of the Selected Titles as now published.

This work has been made possible by the remarkable collection of current periodicals available in the Library of the United Engineering Society, which is by far the greatest in this country and probably in any country. The Library receives, even now, when some of the foreign periodicals have ceased to come to its shelves, close to a thousand different papers, magazines and transactions of societies in the engineering and scientific fields, in not less than ten languages. The Society's engineering staff examines these publications as they are received and prepares the cards ultimately used for the Selected Titles Section in THE JOURNAL.

In the preparation of the Selected Titles Section chief attention is paid to articles directly concerned with the branches of mechanical engineering. When it is thought they will be of interest or value to mechanical engineers, however, other articles are listed, in the realms of physics and chemistry; civil, mining and electrical engineering, technology, etc.; and in subjects in broadly related fields such as training and education, safety engineering, fire protection, employment of labor, welfare work, housing, cost keeping, patent law, public relations, etc.

The system of classification used is that which it is believed has come to be generally regarded as the best, namely, the simple alphabetical arrangement with the articles under heads and sub-heads which are varied from month to month according to the subject-matter to be indexed. Cross-references have been introduced and it is particularly to be noted that where the titles themselves are not sufficiently descriptive, explanatory sentences have been appended. This feature much more than doubles the labor and expense and, we are assured, correspondingly enhances the value of the index to the reader.

PHOTOSTATIC PRINTS

Photostatic copies may be obtained of any of the articles listed in this section.

Price for each print (up to 11 x 17 in. in size), 25 cents, plus postage. A separate print is required for each page of the larger-size periodicals, but where possible two pages will be photographed together on the same print. Bill will be mailed with the prints.

Orders should be sent to

HARRISON W. CRAVER, *Director,*
Engineering Societies Library,
29 West Thirty-ninth Street,
New York.

AERONAUTICS

Aeroplane Design

Directional Stability of an Airplane. Frederick Bedell. Sibley Jl. of Eng., vol. 32, no. 11, August 1918, pp. 166-167. Exposition of the mechanics of directional stability of an airplane.

Balloons

Military Aerostatics. H. K. Black. Aerial Age, vol. 7, no. 20, July 29, 1918, p. 957. Theory of ballooning. (To be continued.)

Engines

Aluminum Pistons for Aero-Engines. Engineer, vol. 126, no. 3262, July 12, 1918, p. 35, 2 figs. Description of the aluminum pistons found in the Benz engine of a captured German plane.

The Design of Aeroplane Engines. John Wallace. Aeronautics, vol. 15, no. 246, July 3, 1918, pp. 10-11, 2 figs. Details of design employed for the purpose of securing a smooth torque and approximate balance of the moving parts of aircraft engines. (Continuation of serial.)

General Problems

Present-Day Problems in Aeronautics. William B. Stout. Motor Travel, vol. 10, no. 2, July 1918, pp. 20-22. From an address delivered before the Society of Automotive Engineers.

Some Outstanding Problems in Aeronautics. W. F. Durand. Aeronautics, vol. 15, no. 246, July 3, 1918, pp. 19-26. Sixth Wilbur Wright Memorial lecture, read before the Aeronautical Society on June 25, 1918.

Individual Types

The A. E. G. Bombing Biplane. Engineer, vol. 125, no. 3258, June 7, 1918, pp. 484-487, 14 figs. Details of construction and performance of a reconstructed captured German biplane.

The Roland D. II Biplane (Biplan Roland D. II). L'Aérophile, year 26, nos. 9-10, May 15, 1918, pp. 129-132, 8 figs.

Instruments

Perfected Aircraft Compass (Compas Perfectionné de Direction, en Navigation Aérienne). H. Vincent. L'Aérophile, year 26, nos. 9-10, May 15, 1918, pp. 133-136, 6 figs. Describes a *multiplex* compass for use in aerial navigation.

To Ascertain the Speed and Direction of Aeroplanes Over the Water. Aerial Age, vol. 7, no. 19, July 22, 1918, pp. 914-915, 2 figs. Exposition of Admiral Fiske's proposed method.

Materials of Construction

Determination of the Permeability of Balloon Fabrics. Junius D. Edwards. Aviation, vol. 5, no. 1, August 1, 1918, pp. 30-33, 6 figs. (To be concluded.)

How Moisture Affects the Strength of Aircraft Fabrics. G. B. Haven. Automotive Industries, vol. 39, no. 3, July 18, 1918, pp. 100-108, 5 figs. Tests on cotton, linen, balloon fabric, tire fabric and cords.

Steel Tubes, Tube Manipulation and Tubular Structures for Aircraft. W. W. Hackett and A. G. Hackett. Automotive Eng., vol. 3, no. 6, July 1918, pp. 259-260. Review of method of manufacture of tubular work and of some of the forms of manipulation upon steel tubing. From a paper read before the Aeronautical Society, London, May 2. (To be continued.)

The Metallurgist and the Aircraft Program. H. F. Wood. Am. Drop Forger, vol. 4, no. 7, July 1918, pp. 281-282. Description of various parts in Liberty motor, showing how design and choice of material are controlled. (To be continued.)

Model Aeroplanes

Model Aeroplane Building as a Step to Aeronautical Engineering. John V. McMahon. Aerial Age, vol. 7, no. 20, July 29, 1918, p. 971, 18 figs. Principles of streamline study.

Propellers

A Résumé of Airscrew Theory. M. A. S. Riach. Aeronautics, vol. 15, no. 246, July 3, 1918, pp. 12-15. An attempt to coördinate the aerofoil and momentum theories of screw propulsion.

Conventional Propeller Calculations. F. W. Caldwell. Aviation, vol. 5, no. 1, August 1, 1918, pp. 21-26, 24 figs.

Notes on Airscrew Analysis. M. A. S. Riach. Aeronautics, vol. 15, no. 247, July 10, 1918, pp. 41-42, 4 figs. Proposed modifications in the theory outlined under the title, The Screw Propeller in Air, in Aeronautics of March 21. (Continued from issue of June 12, 1918.)

The Efficiency of an Airscrew. M. A. S. Riach. Aeronautics, vol. 15, no. 247, July 10, 1918, pp. 38-39. Study of the efficiency of an airscrew approached by a consideration of the efficiency of the various elements forming each blade.

Predicting Strength and Efficiency of Airplane Propellers. F. W. Caldwell. Automotive Industries, vol. 39, no. 3, July 18, 1918, 14 figs. Charts and formulæ for calculating horsepower absorbed and torque delivered at given engine and plane speeds.

The Characteristic Coefficients of a Propeller and Some Methods of Plotting Them. E. P. King. Aeronautics, vol. 15, no. 246, July 3, 1918, pp. 4-9, 6 figs. Study of some problems dealing with the variable-pitch propeller. (Continued from issues of Jan. 2, May 1 and June 19, 1918.)

See also Physics (Meteorology).

AIR MACHINERY

Air Compressors

Air Compressor Troubles. R. J. Bailey. Compressed Air Mag., vol. 23, no. 8, August 1918, pp. 8849-8850. Results obtained from a described arrangement.

Lubrication of Air Compressors. W. H. Callan. Coal Age, vol. 14, no. 5, August 1, 1918, pp. 211-213. Suggests that a fairly light oil might be as successful as a heavy oil.

Note.—The abbreviations used in indexing are as follows: And (&); American (Am.); Associated (Assoc.); Association (Assn.); Bulletin (Bul.); Bureau (Bur.); Canadian (Can.); Chemical or Chemistry (Chem.); Electrical or Electric (Elec.); Electrician (Elecn.); Engineer [s] (Engr. [s]); Engineering (Eng.); Gazette (Gaz.); General (Gen.); Heating (Heat.); Industrial (Indus.); Institute (Inst.); Institution (Instn.); International (Int.); Journal (Jl.); London (Lond.); Machinery (Machy.); Machinist (Mach.); Magazine (Mag.); Marine (Mar.); Mining (Min.); Municipal (Mun.); National (Nat.); New England (N. E.); New York (N. Y.); Record (Rec.); Refrigerating or Refrigeration (Refrig.); Review (Rev.); Railway (Ry.); Society (Soc.); United States (U. S.); Ventilating (Vent.); Western (West.); State names (Ill., Minn., etc.); Proceedings (Proc.); Transactions (Trans.); Supplement (Supp.); Mechanical (Mech.); Scientific (Sci.).

Blowing Engines

1500 HP. Gas Blowing Engine. Engineer, vol. 126, no. 3262, July 5, 1918, p. 16, 2 figs. Description of large gas blowing engine built for the Partington Steel & Iron Co., Ltd.

Shell Plant

Compressed Air in a Shell Plant. R. E. C. Martin and S. B. King. Mine & Quarry, vol. 10, no. 4, July 1918, pp. 1051-1055. Illustrated article describing installation and operation of compressed air at the plant of Winslow Bros. Co., Chicago, Ill.

BRICK AND CLAY

Burning Clay Wares. Ellis Lovejoy. Clay Worker, vol. 70, no. 1, July 1918, pp. 32-82. Deals with up-draft kilns. (Continuation of serial.)

How to Proceed to Cut Burning Costs. J. K. Moore. Brick and Clay Rec., vol. 53, no. 3, July 30, 1918, pp. 207-212, 4 figs. Suggestions to improve the system of burning in an average-size clay plant equipped with round down-draft kilns.

BRIDGES

Arched Steel Cantilevers Used in Park Avenue Viaduct. Harry W. Levy. Eng. News-Rec., vol. 81, no. 2, July 11, 1918, pp. 81-83, 5 figs. Details of viaduct at Grand Central Terminal, New York.

Foundations, Forms and Concrete Distribution Mark Bridge Construction. Edward W. Stearns. Eng. News-Rec., vol. 81, no. 2, July 11, 1918, pp. 68-72, 9 figs. Describes combination unit wood and steel forms and steel arch centers that were used many times.

BUILDING AND CONSTRUCTION

Concrete Houses

Edison House Idea Outdone. Concrete, vol. 13, no. 2, August 1918, pp. 42-46, 15 figs. Layout of 40-house group being built by Ingersoll system, near Elizabeth, N. J.

Interior Construction of the Concrete Industrial House. M. D. Morrill. Contract Rec. & Eng. Rev., vol. 32, no. 30, July 24, 1918, pp. 587-588. Review of the different interior constructions used and suggestions regarding their respective adaptability to various purposes.

Methods of Constructing Concrete Houses, K. H. Talbot. Contract Rec. & Eng. Rev., vol. 32, no. 30, July 24, 1918, pp. 581-584. Résumé of types of forms used in solving the house problem.

Report of American Concrete Institute Committee on Industrial Houses. Eng. & Cement World, vol. 13, no. 2, July 15, 1918, pp. 19-20.

Ten Fireproof Houses of Field and Precast Concrete. Concrete, vol. 13, no. 2, August 1918, pp. 69-71, 12 figs. Description of ten 6-room fireproof dwellings being completed at Ransford, Pa., for the Lehigh Coal & Navigation Co., by the Simpsoncraft system of construction.

Concrete Stairs

Concrete Stairs. A. M. Wolf. Concrete, vol. 13, no. 2, August 1918, pp. 58-60, 8 figs. Designs and design methods.

Earth Pressures

Earth Pressures. Leo Hudson. Can. Engr., vol. 35, no. 3, July 18, 1918, pp. 61-64. Summary of the theories on the subject. Abstract from Trans. Am. Soc. of Municipal Improvements.

Military Buildings

Semi-Military Buildings in the National Army Cantonments. Robert H. Moulton. Architectural Rec., vol. 44, no. 1, July 1918, pp. 21-30. Arrangement and interiors of camp buildings.

Pile Driving

World's Record for Pile Driving. Eng & Contracting, vol. 50, no. 3, July 17, 1918, p. 58. 220 65-ft. piles put down by 11 men in 9 hr. 5 min.

Sandstone

Sawing and Working Sandstone. Stone, vol. 39, no. 7, July 1918, pp. 324-326. Considerations governing the design and construction of a finishing plant in the vicinity of a quarry.

Shipyards

Hog Island's Ship-Erection Equipment Four Hundred Tower Derricks for Fifty Ways. Eng. News-Rec., vol. 81, no. 2, July 11, 1918, pp. 77-80, 7 figs. Description of prominent features and details.

How Shipyard Housing Work Is Organized and Operated. Eng. News-Rec., vol. 81, no. 3, July 18, 1918, pp. 122-124.

Survey of Sites

Surveying for Housing Projects. Mun. Jl., vol. 45, no. 2, July 13, 1918, pp. 28-29. Instructions by Bureau of Industrial Housing and Transportation for making topographical surveys and maps of sites for housing developments.

Wood Mill Buildings

Wood in the Construction of Mill Buildings. W. Kynoch and R. J. Blair. Can. Engr., vol. 35, no. 5, August 1, 1918, pp. 95-96, 2 figs. Corrosive sublimate suggested as preservative where conditions are favorable to growth of fungi.

CEMENT AND CONCRETE

Concrete-Making Plants

Cedar Hollow, Pa., Plant of Charles Warner Co. Concrete (Cement Mill Section), vol. 13, no. 2, August 1918, pp. 13-15, 9 figs. Rotary kiln for lime burning and method of handling the hydrating process.

Gravel Plant of Tarco Construction Co., Cincinnati. Concrete (Cement Mill Section), vol. 13, no. 2, August 1918, pp. 11-12, 2 figs. Arrangement and equipment of the plant.

Concrete Mixes

Effects of Grading of Sand and Consistency of Mix Upon the Strength of Concrete. Llewellyn N. Edwards. Can. Engr., vol. 35, no. 3, July 18, 1918, pp. 49-52, 9 figs. Supplement to the writer's reports of his tests published in the issues of Aug. 16, 23 and 30, and Sept. 6, 1917.

Effect of Time of Mixing on the Strength of Concrete. Duff A. Abrams. Can. Engr., vol. 35, nos. 4 and 5, July 25, 1918, pp. 73-78, 3 figs.: Series of tests on machine-mixed materials; August 1, pp. 103-115, 48 figs.: Tests, diagrams and tables of data obtained from experimental tests. Paper read before Am. Concrete Inst. (To be concluded.)

Method of Proportioning Concrete Mixtures Based on the Surface-Areas of the Aggregates. L. N. Edwards. Western Eng., vol. 9, no. 8, August 1918, pp. 308-309, 5 figs. Series of experiments and theory advanced by writer that the proportion of cement in a given mortar or concrete mixture should depend upon the surface-area of the aggregates.

Slag as an Aggregate for Concrete Ships. Curtis C. Meyers. Iron Age, vol. 102, no. 3, July 18, 1918, pp. 152-154, 4 figs. Slag concrete claimed to be superior to crushed stone or pebble concretes.

The Basic Principle of Concrete Mixes and the Truly Fundamental Role Played by Water. Duff A. Abrams. Eng. & Contracting, vol. 50, no. 4, July 24, 1918, pp. 77-78. Experimental research concerning the effect of water on the strength and other properties of concrete.

The Basic Principle of Concrete Mixes. Duff A. Abrams. Min. & Sci. Press, vol. 117, no. 1, July 6, 1918, pp. 23-24, 1 fig. The effect of water in concrete.

Water and Its Influence on Concrete Mixing. Building News, vol. 115, no. 3314, July 10, 1918, p. 30, 1 fig. Series of tests carried out in the Structural Materials Research Laboratory of the Lewis Institute, Chicago.

Finishes

Problems in Devising a New Finish for Concrete. J. J. Earley. Eng. & Cement World, vol. 13, no. 3, August 1, 1918, pp. 30-32. Abstract of a paper before the Am. Concrete Inst.

Form Work

Efficiency Methods in Form Work. A. B. McDaniel. Concrete, vol. 13, no. 2, August 1918, pp. 61-64, 4 figs. Make-up of forms: erection of forms; wrecking; cost of work.

See also Coal Industry (Mine Concreting); Roads and Pavements (Concrete Pavements).

CHEMICAL TECHNOLOGY

Ammonium Sulphate from Gas Works

Alkali Works Chief Inspector's Report. Gas Jl., vol. 143, no. 2878, July 9, 1918, pp. 62-63. Consideration of the direct process of sulphate of ammonia manufacture in gas works.

Estimation of Polysulphide. W. S. Curphey. Gas Jl., vol. 143, no. 2878, July 9, 1918, p. 69. From author's 1917 annual report as chief alkali inspector.

The Direct Process of Sulphate Making in Gas Works. W. S. Curphey. Gas Jl., vol. 143, no. 2878, July 9, 1918, pp. 68-69. From author's 1915 and 1916 annual reports as chief alkali inspector. (To be continued.)

Analysis

A Standard Apparatus for the Determination of Sulfur in Iron and Steel by the Evolution Method. H. B. Pulsifer. Jl. Indus. & Eng. Chem., vol. 10, no. 7, July 1, 1918, pp. 545-550, 3 figs. Description of the apparatus for determinations by the evolution method using concentrated HCl.

Iodide Copper Method with Sodium Fluoride. A. L. Reese. Eng. & Min. Jl., vol. 105, no. 26, June 29, 1918, p. 1170. Details of a process of determining copper by the iodide process in which the interference of ferric salts is prevented by the addition of sodium fluoride.

Rapid Determination of Carbon in Steel by the Barium Carbonate Titration Method. J. R. Cain and L. C. Maxwell. Jl. Indus. & Eng. Chem., vol. 10, no. 7, July 1, 1918, pp. 520-522. Method developed by Bureau of Standards for use where speed is important.

The Perchlorate Method for the Determination of the Alkali Metals. F. A. Gooch and G. R. Blake. Chem. News, vol. 117, no. 3048, May 24, 1918, pp. 196-198. Desirability of including potassium within the scope of the investigation of the perchlorate precipitation of rubidium and caesium.

Nitrogen Compounds

Nitrogen and Its Compounds. Horace Freeman. Chem. News, vol. 117, nos. 3049 and 3051, June 7, 1918, pp. 205-207. Early attempts to utilize atmospheric nitrogen; discovery of cyanamide; development of the arc process; the Haber process; establishment of the cyanide process in America; July 5, 1918, pp. 231-233. Manufacture of cyanamide and uses of its derivatives. Address before Board of Trade of Niagara Falls, Ont. From the Can. Chem. Jl.

The Formation of Nitrites from Nitrates in Aqueous Solution by the Action of Sunlight, and the Assimilation of the Nitrites by Green Leaves in Sunlight. Benjamin Moore. Proc. Royal Soc., vol. 90, no. B627, June 1, 1918, pp. 158-167. Report of experimental work and compilation of thermochemical determinations.

Potash Recovery

Recovery of Potash. Eng. & Cement World, vol. 13, no. 2, July 15, 1918, p. 68. Chemical and commercial methods for recovering potash from silicates.

Tanning

The Chrome-Tanning Industry. Chem. News, vol. 117, no. 3051, July 5, 1918, pp. 233-235. Processes and reputed advantages.

CLAY

(See Brick and Clay)

COAL INDUSTRY

Coke and By-Products

Coke-Oven By-products in 1917. Colliery Guardian, vol. 116, no. 3002, July 12, 1918, pp. 69-70. Report made under the Alkali Works Act.

Development of the Coke Industry in Colorado, Utah and New Mexico. F. C. Miller. Trans. Am. Inst. Min. Engrs., no. 140, August 1918, pp. 1307-1310.

Recovery of By-products in Coke Manufacture. M. Meredith. Coal Age, vol. 14, no. 2, July 13, 1918, pp. 60-62. Increased use of by-product ovens in Britain; the by-products recovered.

Loading and Handling

An Unloading Tower and Reloading Plant. J. O. Durkee. Coal Industry, vol. 2, no. 8, August 1918, pp. 299-302, 4 figs. Unloading, screening, storing and loading coal at the Island Creek Coal Co.'s plant on the Ohio river at Sekitan.

Marcus Screens at Plants of Carnegie Coal Co., Pennsylvania. Richard G. Miller. Coal Age, vol. 14, no. 4, July 25, 1918, pp. 171-174, 7 figs. Description of coal-cleaning plants.

Mine Concreting

Concrete Foundations, Drift Linings and Reservoirs. J. F. Springer. Coal Age, vol. 14, no. 5, August 1, 1918, pp. 204-210, 8 figs. Suggestions for the use of concrete in and around mines.

Mine Conveying

A Suggestion for Increasing Coal Production. H. D. Levin. Coal Age, vol. 14, no. 3, July 20, 1918, pp. 104-105, 3 figs. Use of light, easily portable loading conveyors suggested.

Mining

A Successful Labor-Saving Machine. N. L. Harmon. Coal Industry, vol. 2, no. 8, August 1918, pp. 290-292, 2 figs. Automatic safety mine-car cages and feeder built by an Ohio concern.

Coal Mining in British Columbia. R. Dunn. Coal Age, vol. 14, no. 2, July 13, 1918, pp. 55-57. New development hampered by cost of material and lack of men. Sales statistics for 1916 and 1917.

Electric Labor-Saving Devices in Coal Mining. Graham Bright. Coal Age, vol. 14, no. 3, July 20, 1918, pp. 116-120, 13 figs.

How Electrical Methods are Speeding Up Coal Mining Operations. Elec. Rec., vol. 24, no. 2, August 1918, pp. 21-23. Details of electrical haulage methods and equipment now used in different mines in Western Pennsylvania and Ohio.

Improvements in Coal Mining Methods. H. H. Stoek. Coal Industry, vol. 2, no. 8, August 1918, pp. 286-289, 5 figs. Suggestions regarding the method of underground mining considering the roof, floor and inclination of seam.

Increased Coal Output by Stripping. A. C. Vicary. Coal Age, vol. 14, no. 3, July 20, 1918, pp. 94-96, 4 figs. Advocates use of this method wherever possible.

Model Safety-First Coal Mine in Central Illinois. Coal Age, vol. 14, no. 1, July 6, 1918, pp. 4-10, 10 figs. Features of the Madison Coal Corporation's mine.

Some of the Coal Producer's Problems. D. H. McDougall. Can. Min. Jl., vol. 39, no. 11, June 1, 1918, pp. 183-184. Presidential address before the Mining Society of Nova Scotia.

The Eastern Middle-Anthracite Field. E. B. Wilson. Coal Industry, vol. 2, no. 8, August 1918, pp. 292-294, 4 figs. Third of a series on practical geology, describing and giving thickness, area and level of the measures of the eastern middle Pennsylvania anthracite coal field.

Working a Thin Seam by Coal Cutters and Face Conveyors. S. T. Boam. Iron & Coal Trades Rev., vol. 97, no. 2627, July 5, 1918, pp. 12-13, 2 figs. From a paper before the South Midland Branch of the Nat. Assn. of Colliery Managers.

Trip Feeders

Trip Feeders. C. L. Miller. Coal Industry, vol. 2, no. 8, August 1918, pp. 307-308, 3 figs. Formulae, curves, data and drawings for trip-feeder design.

Washing

The Emergency and Clean Coal. G. H. Elmore. Coal Age, vol. 14, no. 3, July 20, 1918, pp. 122-126, 8 figs. Suggests more modern coal washeries.

See also Fuels and Firing (Coke).

CONVEYING

(See Hoisting and Conveying)

COOLING

Cooling of Condenser Water by Towers and Spraying. E. W. Marriott. Indus. Australian & Min. Standard, vol. 59, no. 1544, June 13, 1918, pp. 621-622, 6 figs.

DRYDOCKS

Construction of Pearl Harbor Drydock Completed. Eng. News-Rec., vol. 81, no. 4, July 25, 1918, pp. 173-177, 7 figs. Novel method of placing unit sections of concrete base and walls from floating drydock and building upper works in movable cofferdams.

EARTHWORK

Excavations

Blasting Methods at Ajo, S. U. Champe. Min. & Sci. Press, vol. 117, no. 2, July 13, 1918, pp. 46-48, 6 figs. Description of ore excavation methods.

Blasting Methods at Ajo, S. U. Champe. Western Eng., vol. 9, no. 8, August 1918, pp. 326-328, 6 figs. Methods of preparing the ground to receive the charges for blasting employed in the copper mountain deposit at Ajo, Ariz., belonging to the New Cornelia Copper Co.

The Tailing Excavator at the Plant of the New Cornelia Copper Co., Ajo., Ariz. F. Moeller. Tran. Am. Inst. Min. Engrs., no. 140, August 1918, pp. 1229-1234, 6 figs. Extension of the use for which the mechanical unloader was first designed.

Levee Construction

Levee Construction in North Texas with Draglines. O. W. Finley. Eng. & Contracting, vol. 50, no. 3, July 17, 1918, pp. 65-66. A description of reclamation work with cost figures and present values.

ELECTRICAL ENGINEERING

Alternating-Current Engineering

Characteristic Curves and Conditions of Stability of an Operating System. (Sur les courbes caractéristiques et les conditions de stabilité des régimes). J. Bethenod. Revue Générale de l'Electricité, vol. 4, no. 2, July 13, 1918, pp. 35-36, 1 fig. Study of a particular case of spontaneous inception of oscillatory phenomena.

Batteries

Dry Cells and Wet Batteries. William J. Herdman. Electricity, vol. 32, no. 1443, July 5, 1918, p. 355. Care of Lalande Cells. (Continued.)

Eddy Currents

On Copper and Iron Losses in Alternating Current Machine with Deep Slots (in Japanese). T. Isshiki. Denki Gakkwai Zasshi, no. 358, May 31, 1918.

Hysteresis Losses in Iron (Remarque sur les pertes dans le fer par hystérésis). M. Latour. Revue Générale de l'Electricité, vol. 4, no. 2, July 13, 1918, pp. 36-37. Determination of the relation between the hysteresis angle τ and the Steinmetz coefficient η. Remarks on a similar study by the same writer published in the issue of April 13, 1918.

Electric Furnace

The Manufacture of Ferro-Alloys in the Electric Furnace. R. M. Keeney. Tran. Am. Inst. Min. Engrs., no. 140, August 1918, pp. 1321-1373. Processes followed in the manufacture of ferrochrome, ferromanganese, ferromolybdenum, ferrotungsten, ferrovanadium and ferrouranium.

Electrodeposition of Metals

The Deposition of Nickel Upon Cast Iron from a Hot Electrolyte. Royal F. Clark. Metal Industry, vol. 16, no. 7, July 1918, p. 309. From a paper before the Electro-Platers Society, July 1918.

The Maintenance of High Ampere Efficiency in Electrolytic Copper Refining. M. H. Morriss and M. A. Mosher. Eng. & Min. Jl., vol. 106, no. 3, July 29, 1918, pp. 95-99, 8 figs. Practical notes on methods to secure high ampere efficiency, details as to correct method of hanging and controlling sheets; use of volt-meter to detect short-circuits and bad contacts.

Electrolysis

Electrolysis Mitigation. Scientific Am. Supp., vol. 86 nos. 2220 and 2221, July 20, 1918, pp. 46-47: Discussion of causes and methods of regulating electrolytic conditions of underground structures; July 27, p. 58: Essentials in electrolysis regulations.

Generators

Rewinding and Reconnecting Direct Current Armature Windings for a Change in Voltage. T. Schutter. Elec. Eng., vol. 52, no. 1, July 1918, pp. 45-48, 5 figs. Describes practical methods.

Heating

Electrically Heated Devices. Elec. Rec. vol. 24, no. 2, August 1918, pp. 82k-82r. Tables giving trade name, size or capacity, wattage, number of heat-units, cost to operate, voltage and retail price of electrically heated devices.

High-Frequency Currents

On the Discharge Between Metallic Electrodes and Continuous Electric Oscillations. H. Yagi. Jl. of the College of Engineering, Tokyo Imp. Univ., vol. 9, no. 4, February 28, 1918, pp. 115-152, 27 figs. Experiments on discharges in air and in coal gas; oscillations; Wien's quenched spark gaps; secondary oscillation; fluctuation of the secondary current.

Radiotelegraphy. G. E. Mitchell. Scientific Am. Supp., vol. 86, no. 2223, August 10, 1918, pp. 88-90. Uses and possibilities of radiotelegraphy in the war.

Wave Velocity and Capacity of Horizontal Helices in Wireless Telegraphy and Transmission Line Protective Apparatus. A. Press. Elecn., vol. 81, no. 6, June 7, 1918, pp. 106-107. A mathematical treatment.

High-Tension D. C. Current

Very High Tension Direct Current for Laboratory Use (La production du courant continu à très haute tension pour laboratoire d'essai). Jean Saroléa. Revue Générale de l'Electricité, vol. 4, no. 1, July 6, 1918, pp. 4-8, 3 figs. Description of apparatus to obtain very high-tension continuous currents in a laboratory by means of Fleming valves.

Insulators

Extra-High-Tension Insulators (in Japanese). H. Tachikawa. Denki Gakkwai Zasshi, no. 359, June 30, 1918. Paper read before the meeting of Tokyo Local Section. (Continued.)

Lamps

Management of Lamp Works. T. Nakagawn (in Japanese). Denki Gakkwai Zasshi, no. 354, January 1918, pp. 97-105.

Proposed Standardization of the Thread of Edison Base Lamps (Projet d'unification des filetages des culots de lampes à vis Edison). Ch. Zetter. Revue Générale de l'Electricité, vol. 4, nos. 1-4, July 6-27, 1918, pp. 9-21, 39-49, 73-84, 105-112, 10 figs. Comparative notes on work done by the Commission of the Union of Syndicates of Electricity with reference to the standardization of small electrical appliances.

Lightning Arrester

New Type of Lightning Arrester Makes Its Appearance. Elec. Ry. Jl., vol. 52, no. 3, July 20, 1918, pp. 101-102, 4 figs. The "oxide film" arrester has general properties of the aluminum cell arrester with additional features.

Magnetism

Hypothetical Theory on Magnetization of Magnetic Substances (in Japanese). T. Takenchi. Denki Gakkwai Zasshi, no. 358, May 31, 1918.

Magnetic Susceptibility and Electric Resistivity. F. H. Loring. Chem. News, vol. 117, no. 3051, July 5, 1918, pp. 229-231, 4 figs. Additional notes to a previous general paper on magnetic susceptibility.

Motors

Indirect Construction of the Precise Diagram for Rotating Field Motors. (Construction indirecte du diagramme rigoureux des moteurs à champ tournant). V. Genkin. Revue Générale de l'Electricité, vol. 3, no. 26, June 29, 1918, pp. 931-933, 4 figs. Graphical construction of the cyclic diagram of a rotating field motor, taking into consideration the resistance of the stator.

On the Sub-Synchronous Speed of Squirrel-Cage Induction Motors (in Japanese). L. Takeshi. Denki Gakkwai Zasshi, no. 356, March 31, 1918.

Precipitators

Electrical Precipitation from Flue Gas. Iron Age, vol. 102, no. 5, August 1, 1918, p. 273, 3 figs. High-voltage direct current passed through chains hanging in flue from a copper refinery electrifies metallic particles, projecting them against grounded wall where they drop into hoppers.

New Electrical Precipitation Treater (in Japanese). M. Shibusawa. Denki Gakkwai Zasshi, no. 354, January 1918, pp. 61-87.

Resistance and Light

Substances of Variable Resistance Under the Action of Light (Corps à résistroité variable sous l'action de la lumière). M. Case. Revue Générale de l'Electricité, vol. 3, no. 25, June 22, 1918, p. 889. Process employed to find other substances than selenium of variable resistance under the action of light; results obtained.

Roentgen Rays

Discussion on Recent Development of Roentgen Radiation (in Japanese). Denki Gakkwai Zasshi, no. 355, February 1918, pp. 167-171.

Rotary Converters

Starting Rotary Converter. F. D. Newbury and M. W. Smith. Power Plant Eng., vol. 22, no. 12, June 15, 1918, pp. 499-500, 2 figs. Comparison of results with transformer secondaries connected to collector rings and when alternating-current circuit is open.

Starting Rotary Converters. W. R. Bowker. Elec. Eng., vol. 52, no. 1, July 1918, pp. 40-42, 10 figs. Analysis of the problem and exposition of present methods used to solve it.

Storage Battery

Developments in the Use of Storage Batteries. G. F. Wakeman. Jl. of Elec., vol. 41, no. 3, August 1, 1918, pp. 120-121. Some of the present applications and future possibilities.

Switchgear

Automatic Control of Electric Heaters, Valves and Similar Apparatus. G. E. Palmer. Electricity, vol. 32, no. 1442, June 28, 1918, pp. 341-342, 2 figs. Diagrams of switch connections for automatic control of electric heaters, valves, etc.

Some Considerations Relating to Large Power Station Switchgear. H. W. Clothier. Elecn., vol. 81, no. 9, June 28, 1918, pp. 175-179, 11 figs. Deals particularly with oil switches for large outputs. Controlling factors in design. Drawings of a form of switchgear in successful operation and suitable for use in a station of 60,000 kw.

Three- and Four-Way Switch Circuits. Terrell Croft. Elec. Eng., vol. 52, no. 1, July 1918, pp. 19-21. Diagrams and explanations of the wiring connections for several three- and four-way circuits. (To be continued.)

Telephones

Leeds Automatic Exchange. J. Hedley. Elecn., vol. 81, no. 5, May 31, 1918, pp. 84-87, 6 figs. Description of a new telephone exchange of the full automatic Strowger type, five-figure system.

New Private Branch Exchange Switchboard of Bell System (in Japanese). S. Oshida. Denki Gakkwai Zasshi, no. 357, April 30, 1918.

Transformers

Discussion on Resonance Phenomena in High Voltage Transformers (in Japanese). H. Yagi. Denki Gakkwai Zasshi, no. 354, January 1918, pp. 131-135.

Higher Harmonics in the Magnetizing Current of a Single-Phase Transformer (in Japanese). K. Takamoto. Denki Gakkwai Zasshi, no. 355, February 1918, pp. 171-191.

Outdoor Water-Cooled Transformers. R. von Fabrice. Power, vol. 48, no. 6, August 6, 1918, pp. 198-199, 1 fig. Necessary equipment to handle oil and to furnish a suitable cooling-water supply for outdoor water-cooled oil-insulated transformers.

Resonance Phenomena in High Voltage Transformers (in Japanese). K. Nishi. Denki Gakkwai Zasshi, no. 358, May 31, 1918. (Continued.)

Transmission Lines

Air-Break Switches and Auxiliary Equipment for Outdoor Substations. Elec. Rec., vol. 24, no. 2, August 1918, pp. 42-51. Diagrams and illustrations of present types.

Characteristics of Iron and Steel Conductors. Charles E. Oakes and P. A. B. Sahm. Elec. World, vol. 72, no. 4, July 27, 1918, pp. 150-151. Complete test data for calculation of electrical characteristics of iron and steel conductors.

Charging Currents and Earthing Devices in Transmission Lines. H. Behrend. Elecn., vol. 81, no. 11, July 12, 1918, pp. 222-223, 3 figs. Abstract of an article in the Elektrotechnische Zeitschrift, no. 25, 1917.

Computation of Inductive Circuits in Parallel (Calcul des circuit inductifs en dérivation). H. Pécheux. Revue Générale de l'Electricité, vol. 3, no. 25, June 22, 1918, pp. 891-894, 5 figs. Attempt to show that it is possible to solve problems of technical electricity by means of vectors and projections without using imaginary quantities.

Connections of Subterranean High-Tension Cables (Juntas de los cables subterráneos a alta tensión). H. Aldum. Boletin de la Asociacion Argentina de Electro-Técnicos, vol. 4, no. 2, February 1918, pp. 639-645. Résumé of a conference before the Physics Institute of La Plata. (To be continued.)

Heating of Underground Cables (in Japanese). T. Yoneda. Denki Gakkwai Zasshi, no. 357, April 30, 1918.

On the Abacus for Calculating the Resistance of Parallel Conductors (Sur les abaques relatifs au calcul de la resistance des conducteurs associés en parallele). L. Zoretti and J. Bethenod. Revue Générale de l'Electricité, vol. 3, no. 26, June 29, 1918, pp. 933-934. Remarks on M. Custex's article on the resistance of parallel conductors published in issue of March 23.

On the Distribution of Potential Along the String of the Suspension Insulator (in Japanese). H. Sagusa. Denki Gakkwai Zasshi, no. 357, April 30, 1918.

Practical Study of Transmission Lines by Means of Hyperbolic Functions with Imaginary Variables (Calcul pratique des lignes de transmission électriques par les fonctions hyperboliques des variables imaginaires). G. Viard and M. Latour. Revue Générale de l'Electricité, vol. 4, no. 3, July 20, 1918, pp. 67-71, 3 figs. Review of the computations for transmission lines by means of hyperbolic functions with imaginary variable quantities; description of a graph which permits the determination of the tension and the current at any point in a transmission line, taking into consideration the resistance, inductance, capacity and losses of the line.

Providing Strength and Attractiveness in Special Overhead Supports. Charles R. Harte. Elec. Ry. Jl., vol. 52, no. 3, July 20, 1918, pp. 92-95, 12 figs. Discussion of various types of overhead bridges and other special structures.

Public Safety and High and Low Tension Overhead Transmission Systems (La seguridad pública y las lineas aéreas de alta y baja tensión). F. Linderman. Boletin de la Asociacion Argentina de Electro-Técnicos, vol. 4, no. 1, January 1918, pp. 617-621. Recommendations of several practices in the arrangement of transmission systems.

Sag-Calculation for Iron-Wire Lines. M. D. Leslie. Elec. World, vol. 72, no. 5, August 3, 1918, pp. 196-197, 1 fig. Stringing iron wire with less sag suggested as a practicable war-time economy where the usual safety factor is not essential and weather conditions are not severe. A formula to apply is given.

The Test Sheath Cable and Its Potentialities. C. J. Beaver. Elecn., vol. 81, no. 10, July 5, 1918, pp. 204-205, 3 figs. Description of a construction such that injurious effects from outside and leakage from inside the cable are bound to be interrupted by the test-sheath conductor.

See also Foundry (Electric Furnace); Hydraulics (Hydroelectric Plants); Marine Engineering (Electric Propulsion); Metallurgy (Copper Refining); Motor-Car Engineering (Electric Vehicles); Physics (Electricity); Power Generation (Electric Power Applications).

ENGINEERING MATERIALS

Boiler Plates

A Cause of Failure in Boiler Plates. Walter Rosenhain and D. Hanson. Engineering, vol. 105, no. 2738, June 21, 1918, pp. 692-694, 8 figs. The failure of a boiler plate in the last stages of manufacture accounted for by the phenomena of grain growth in the steel. From a paper read before the Iron & Steel Inst.

Brass

Brass Weakness. James Scott. Metal Industry, vol. 16, no. 7, July 1918, pp. 319-320, 3 figs. A microscopical explanation.

Bronze

Manganese in Aluminum Bronze. Charles Vickers. Brass World, vol. 14, no. 7, July 1918, pp. 202-203, 2 figs. Effect of manganese in aluminum bronze; results of tests.

Cast Iron

Cast Iron at High Temperatures. Power, vol. 48, no. 4, July 23, 1918, pp. 120-121, 3 figs. Data from several sources, with curves.

Malleable Cast Iron. E. Turner. Page's Eng. Weekly, vol. 32, no. 720, June 28, 1918, pp. 304-306. Methods of producing malleable cast iron and theory of the malleablelizing process. (To be continued.) Paper presented at a meeting of the West of Scotland Iron and Steel Institute.

Glass

Strength of Circular Flat Plate of Glass. W. Richards. Mechanical World, vol. 63, no. 1637, May 17, 1918, p. 235, 1 fig. Account of the testing of a piece of ordinary plate glass.

Non-Ferrous Alloys

The Hardness of Alloys of Non-Ferrous Metals. P. Ludwik. Brass World, vol. 14, no. 7, July 1918, p. 207. Compilation of experimental results.

Road Materials

Apparent Specific Gravity of Fine Non-Bituminous Highway Material. Good Roads, vol. 16, no. 6, pp. 48-52, 2 figs. Tentative tests proposed by Committee D-4 of the Am. Soc. of Testing Materials for sand, stone and slag screenings and similar materials.

Rubber

Vulcanization of Rubber by Selenium. Charles R. Boggs. Chem. News, vol. 117, no. 3048, May 24, 1918, pp. 199-200.

Tungsten

Raw Materials Necessary in the Electrical Industry: Tungsten (De quelques matières premières nécessaires à l'industrie électrique: le tungstène). D. Pector. Revue Générale de l'Electricité, vol. 4, no. 3, July 20, 1918, pp. 87-94. History and metallurgy of tungsten; principal deposits of its ore. (To be continued.)

Wire Rope

Splicing Wire Rope. Western Eng., vol. 9, no. 8, August 1918, pp. 313-314. Sketches explaining splicing in its different stages. Abstract from Leschen's "Hercules," March 1918.

The Factor of Safety of Wire Ropes. S. A. Mining Jl. & Eng. Rec., vol. 27, no. 1393, June 8, 1918, pp. 146-147. Discussion of a previous paper giving empirical values for the factor of safety of wire ropes used for winding in mine shafts. (To be continued.)

Wood

Relative Resistance of Various Hardwoods to Injection with Creosote. Ry. Rev., vol. 63, no. 3, July 20, 1918, pp. 79-86, 12 figs. From Bul. 606, U. S. Dept. of Agriculture by Clyde H. Teesdale and J. D. McLean.

See also Aeronautics (Materials of Construction); Building and Construction (Sandstone); Cement and Concrete; Fuels and Firing (Soot Cleaners); Refractories; Roads and Pavements (Road Materials); Steel and Iron (Nicu Steel).

FACTORY MANAGEMENT

Non-Repetitive Work

Managing Non-Repetitive Work. Norman Howard. Indus. Man., vol. 56, no. 1, July 1918, pp. 55-58. How conditions and operations can be standardized for tool-making and machine-shop repairs.

Shifts

Changing Power Plant Shifts. J. C. Hawkins. Power, vol. 48, no. 6, August 6, 1918, pp. 202-203, 1 fig. How a schedule of change of watches was arranged in a plant employing three shifts, each working 8 hr. each.

Shop Management

Working Out a Theory in Shop Management. Am. Mach., vol. 49, no. 4, July 25, 1918, pp. 145-147. The method of the White Motor Co. in running the shop on commission and giving the men a direct voice in the management.

Workmanship as an Efficiency Aim. C. W. Starker. Indus. Man., vol. 56, no. 1, July 1918, pp. 25-26. Points out the danger of sacrificing workmanship for money-making instinct and quantity output in the wrong application of efficiency schemes.

Special Work

Money-Saving Factors in the Maintenance of Special Work. R. C. Cram. Elec. Ry. Jl., vol. 52, no. 3, July 20, 1918, pp. 103-108, 11 figs. Necessity of intelligent selection of special work, careful workmanship in installation and accurate records of performance and prompt attention to repairs.

FOUNDRY

Brass Furnace

The Care of the Brass Furnace. J. A. Fletcher, Jr. Metal Industry, vol. 16, no. 7, July 1918, p. 310, 1 fig. The experience of a large foundry with high-melting-point metals.

Castings

Electric v. Converter Castings. C. R. Messenger. Page's Eng. Weekly, vol. 33, no. 722, July 12, 1918, p. 14. Figures and facts based on 2029 tests with an electric, and 2436 with a converter, furnace. From a paper read before the Am. Foundry Men's Assn.

Manufacturing Heavy Malleable Iron Castings. A. Walter Lorenz. Foundry, vol. 46, no. 312, August 1918, pp. 350-351, 2 micrographs.

Cupola

Advantages Offered by the Oil-Fired Cupola. W. S. Dickson. Foundry, vol. 46, no. 312, August 1918, pp. 381-382, 2 figs. In the process described, crude oil is sprayed directly onto the coke bed to increase the heat and reduce the amount of coke used.

Electric Furnace

The Webb Electric Steel Furnace. Iron Age, vol. 102, no. 5, August 1, 1918, pp. 257-260, 4 figs. A high-voltage unit developed and operated by the Old Dominion Iron & Steel Corporation; low-carbon steel for engine bolts.

Grinding

The Economical Foundry Use of Grinding Wheels. W. T. Montague. Foundry, vol. 46, no. 312, August 1918, pp. 362-367, 8 figs. What wheels to use and how they should be operated to obtain the best results in casting work; safety factors. Paper read at the Metals division of the Am. Inst. of Min. Engrs.

Molding

Why the Inclined Mold is a Fallacy. R. R. Clarke. Foundry, vol. 46, no. 312, August 1918, pp. 351-352.

Patternmaking

Emergency Patterns for a Seven-Foot Gear. J. L. Gard. Foundry, vol. 46, no. 312, August 1918, p. 361, 2 figs.

Making a Pattern for a Gas Engine Cylinder. Frank B. Raebig. Foundry, vol. 46, no. 312, August 1918, pp. 383-385, 14 figs. Construction of core boxes also described, as well as two methods of molding (with necessary pattern changes).

Patternmaking and Molding Cast Tooth Gears. Jabez Nall. Foundry, vol. 46, no. 312, August 1918, pp. 377-380, 9 figs. Practice of a generation ago contrasted with that of today and a gear-molding machine discussed.

Sand Blast

The Sand Blast in the Foundry. H. L. Wadsworth. Brass World, vol. 14, no. 6,

June 1918, pp. 174-175. Two classes of sand blasting; rotary table machines; kinds of abrasives; suggestions as to compressors. From a paper read before the Am. Foundrymen's Assn.

Welding

Welding Propellers in Panama Canal Foundry. John H. Moffett. Foundry, vol. 46, no. 312, August 1918, pp. 356-358, 6 figs. How blades are repaired by burning-on, with a comparison of costs with autogenous processes; making the molds and pouring the metal.

FORGING

Electric Power

The Electrical System of the Forge Shop. Edward McLlvried. Am. Drop Forger, vol. 4, no. 7, July 1918, pp. 271-272, 1 fig. Applications of electric power and discussion of two methods of driving machinery.

Electric Steel

Electric Steel for the Forging Industry. Arthur V. Farr. Am. Drop Forger, vol. 4, no. 7, July 1918, pp. 264-267, 6 figs. Two methods of manufacturing electric steel.

Forge-Shop Design

The Problem of Forge Shop Design. J. T. N. Hoyt. Am. Drop Forger, vol. 4, no. 7, July 1918, pp. 262-263, 3 figs. Typical examples of forge-shop designs and detailed descriptions of construction.

Hollow Forgings

Development of Flaws in Hollow Forgings. A. S. Hesse. Am. Mach., vol. 49, no. 4, July 25, 1918, pp. 153-154, 3 figs. Improper methods of forging which develop flaws in hollow forgings such as gun tubes. Proper remedies suggested.

Quenching Oils

Question of Quenching Oils for Forgings. George W. Pressell. Am. Drop Forger, vol. 4, no. 7, July 1918, pp. 273-277, 6 figs. Report of experiments showing values of different substances in quenching steel.

FUELS AND FIRING

Chimneys

Tall Chimneys in Metallurgical Plants. Eng. & Min. Jl., vol. 106, no. 4, July 27, 1918, pp. 168-171, 13 figs. List of world's tallest chimneys in metallurgical plants.

Coal

Coal—Its Origin and Composition. H. B. Miller. Queensland Government Min. Jl., vol. 19, no. 217, June 15, 1918, pp. 263-265. Length of time to form 1 ft. of peat, interval between coal beds, data on sulphur in coal and calorific value of coal.

Coal Analysis

Analysis of Canadian Fuels. (In five parts.) Bulletins 22-26, Canada Department of Mines, Mines Branch. Tables giving the composition, condition and value of samples from each one of the areas in the coal districts of Canada.

Determination of Volatile Matter and Ash in Coal. Norton H. Humphrys. Gas World, vol. 68, no. 1771, June 29, 1918, pp. 436-437. Proposed device and procedure.

Coal Evaluation

An Alinement Chart for the Evaluation of Coal. A. F. Blake. Jl. Indus. & Eng. Chem., vol. 10, no. 8, August 1, 1918, pp. 627-629, 1 fig. Chart for determining the relative values of different coals, given the price per ton and the chemical analysis.

Coal Selection

Coal and Its Selection—A Factor in Power Plant Management. R. June. Concrete (Cement Mill Section), vol. 13, no. 2, August 1918, pp. 16-19, 4 figs. Classification of coals; question of size; influence of moisture; ash problem; heating value; purchase of coal under specifications.

Coal Storage

Detailed Facts About Storing Soft Coal. H. H. Stoek. The Black Diamond, vol. 61, no. 3, July 20, 1918, pp. 48-49, 4 figs. Suggestions for obviating the difficulties and dangers in storing soft coal. (Concluded.)

Storing Coal at Mooseheart, Illinois. Power, vol. 48, no. 3, July 16, 1918, pp. 76-78, 2 figs. A flexible system of portable conveyors. Circular systems of piling. Estimated cost of storing and reclaiming 20 cents per ton.

Coke

Mechanical Condition of Blast Furnace Coke. G. D. Cochrane. Iron Age, vol. 102, no. 4, July 25, 1918, pp. 202-203, 1 fig. Machine for testing hardness; effect on coke consumption in blast furnaces; action of gases on hard and soft coke. From a paper read before the Iron & Steel Inst., London, May 1918.

Fuel Saving

Concrete Examples of Coal Conservation. H. E. Dart. The Locomotive, vol. 32, no. 2, April 1918, pp. 34-43, 2 figs. How the Hartford Steam Boiler Inspection and Insurance Co. has reduced the average coal consumption in its office building by about 25 per cent. (From the Hartford Courant.)

Fuel Saving in Power Plants. Railroad Herald, vol. 22, no. 8, July 1918, pp. 164-165. Fundamentals of the approved national plan of organization in connection with conservation of fuel in power plants throughout the United States.

Fuels. E. R. Knowles. Steam, vol. 22, no. 2, August 1918, pp. 35-41, 4 figs. Classification of fuels and study of their respective features.

Furnaces

Adapting Furnaces to Available Fuel. Osborn Monnett. Power Plant Eng., vol. 22, no. 13, July 1, 1918, pp. 524-526, 7 figs. Proportions and arrangements of baffles in hand-fired furnaces.

Natural Gas

Gasoline from Natural Gas by Compression. W. P. Dykema. Compressed Air Mag., vol. 23, no. 8, August 1918, pp. 8852-8854. Theory of precipitation; condensation by cooling; condensation by compression; absorption theory; use of combination compression and refrigeration process. (From Bureau of Mines Bul.)

The Compression Process for Extracting Natural Gas from Gasoline. W. P. Dykema. Western Eng., vol. 9, no. 8, August 1918, p. 310. Data compiled from Bul. No. 151, issued by the U. S. Bureau of Mines on the Recovery of Gasoline from Natural Gas by Compression and Refrigeration.

Oil Fuel

Supply of Oil Available from Shales. G. Egloff and J. C. Morrell. Oil and Gas Jl., vol. 17, no. 10, August 9, 1918, pp. 46-48. Chemical constitution of clays, shales and slates.

What Substitution of Oil for Coal Can do. Steam, vol. 22, no. 2, August 1918, pp. 47-49. Results obtained at different plants in New England with fuel oil, which is being supplied them on account of the scarcity of coal.

Peat

Distillation of Peat. R. Hauser. Colliery Guardian, vol. 116, no. 3002, July 12, 1918, p. 72. Results of experiments on peat.

Powdered Coal

Coal Conservation in Fact. C. R. Knowles. Elec. Rev., vol. 72, no. 26, June 29, 1918, pp. 1078-1079. Writer believes coal in gaseous and pulverized form must eventually replace lump for true conservation.

Control of Combustible and Air in Burning Powdered Coal. W. G. Wilcox. Compressed Air Mag., vol. 23, no. 8, August 1918, pp. 8839-8841. Effect of grinding coal on its fuel efficiency and study of the methods for mixing air and powdered coal. From a paper read before the Western New York section of the Am. Chem. Soc.

Mixer and Feeder for Powdered Coal. Compressed Air Mag., vol. 23, no. 8, August 1918, p. 8842. "Lopulco" powdered fuel mixing and feeding apparatus of the Locomotive Pulverized Fuel Co., New York.

The Possibilities of Powdered Coal. W. G. Wilcox. Scientific Am. Supp., vol. 86, no. 2221, July 27, 1918, pp. 62-64. Report of experiments. Paper delivered before the Western New York Section of the Am. Chem. Soc.

Use of Pulverized Coal at the Bunker Hill and Sullivan Smelting and Refining Plant. C. T. Rice. Eng. & Min. Jl., vol. 106, no. 3, July 20, 1918, pp. 91-94, 6 figs. Holbeck return system for the use of pulverized coal, with application to boilers, furnaces and kettles.

Smokeless Combustion

Combustion and Smokeless Furnaces. J. W. Hays. Steam, vol. 22, no. 2, August 1918, pp. 44-46. Laws governing combustion; exposition of the different heat theories; mechanical equivalent of heat. (To be continued.)

The Carbonization of Bituminous Coal. C. T. Malcolmson. Coal Industry, vol. 2, no. 8, August 1918, pp. 295-297. Account of process for the manufacture of smokeless fuel followed during the last three years at Irvington, N. J., in a series of experiments conducted for Blair & Co. of New York. Paper to be presented before the Am. Inst. Min. Engrs.

Soot Cleaners

Why Cast Iron Protects Soot Cleaner Elements against High Temperature. Popular Engr., vol. 10, no. 1, July 1918, pp. 23-26, 6 figs. Study and conclusions of the Vulcan Soot Cleaner Co. of Du Bois, Pa.

See also Brick and Clay; Railroad Engineering, Steam (Locomotive Fuel).

GAS POWER

See Internal-Combustion Engineering; Fuels and Firing (Natural Gas); Producer Gas.

GAS PRODUCERS

(See Producer Gas)

HEATING

Boilers

Some Failures of Cast-Iron Heating Boilers. E. Mason Parry. The Locomotive, vol. 32, no. 2, April 1918, pp. 43-49, 5 figs. Example demonstrating the author's claim that the failure of cast-iron sections of a cast-iron boiler is due in practically every case to the overheating of surfaces exposed directly to the products of combustion, through allowing the water level in the boiler to recede below that which has been predetermined by the designer.

Electric

Electric Heating in Manufacturing. Thomas Robson Hay. Indus. Management, vol. 56, no. 1, July 1918, pp. 53-55. Advantages of electric heating and practical points in installing and operating electric heating equipment.

Heating Systems

Fuel Saving Heating Systems. Alfred G. King. Domestic Eng., vol. 84, no. 4, July 27, 1918, pp. 116-150, 3 figs. Details of construction of an accelerated hot-water heating system.

Reasons for Failures of Heating Systems. J. D. Hoffman. Heat. & Vent. Mag., vol. 15, no. 7, July 1918, pp. 13-18. Effect of poor building construction; space restrictions in warm-air furnace heating. From a paper before the Am. Soc. of Heat. & Vent. Engrs., Buffalo, June 1918.

Returning Condensation in High and Low Pressure Heating Systems. C. L. Hubbard. Domestic Eng., vol. 84, no. 6, August 10, 1918, pp. 197-198, 4 figs. Notes on various methods of saving condensation in both high and low-pressure heating systems. (To be continued.)

Hot-Water Service

Hot Water Service. M. W. Ehrlich. Power Plant Eng., vol. 22, no. 12, June 15, 1918, pp. 489-491, 3 figs. Outlines methods for calculating heating surface required.

Steam

Dripping One-Pipe Steam-Heating Systems. Albert L. Baum. Power, vol. 48, no. 6, August 6, 1918, pp. 194-195, 6 figs. Ways of obviating noises and rendering quick heating an easy matter.

Substations

The Heating of Substations. R. von Fabrice. Power, vol. 48, no. 4, July 23, 1918, pp. 129-130. Considers the heat losses from the electrical equipment and gives a practical illustration.

Temperature Control

Temperature Control in Modern Heating Systems. Charles L. Hubbard. Domestic Eng., vol. 84, no. 3, July 20, 1918, pp. 78-81, 22 figs. Notes on the installation and operation of temperature-regulating devices and their value in connection with fuel conservation. (Continued.)

Workshops

Factory Heating. C. L. Hubbard. Steam, vol. 22, no. 2, August 1918, pp. 33-35. Computations for heat loss and steam requirements. (To be continued.)

Steam-Heating of Workshops. Mechanical World, vol. 63, no. 1637, May 17, 1918, pp. 236-237. Factors involved in the calculation of the size of heating apparatus necessary for a given building.

The Heating and Ventilation of Workshops. Engineer, vol. 126, no. 3262, July 5, 1918, pp. 4-5, 1 fig. Heating arrangements of a 927-ft. building.

See also Electrical Engineering (Heating).

HOISTING AND CONVEYING

Conveying Machinery

How to Move Materials by Machinery. Henry J. Edsall. Indus. Management, vol. 56, no. 1, July 1918, pp. 42-49, 22 figs. Application of various types of elevating and conveying machinery to the handling of coal, crushed stone, cement in bags, and packages and vegetables in a canning establishment, with a per-hour capacity in each case.

Hoisting by Stages

Hoisting by Stages from Deep Mines. R. A. Balzari. Min. & Sci. Press, vol. 117, no. 2, July 13, 1918, pp. 57-58, 2 figs. Description of hoist at Argonaut mine, California.

Hoists

Practical Hints in Bucket-Elevator Operation. A. M. Nicholas. Queensland Government Mining Jl., vol. 19, no. 217, June 15, 1918, pp. 267-268. From a paper read before the Am. Inst. Min. Engrs.

The New Portland Municipal Elevator. Henry Blood. Eng. & Cement World, vol. 13, no. 3, August 1, 1918, pp. 19-22, 4 figs. Details of construction.

Loco Tractor

A New System of Transport. Engineer, vol. 125, no. 3261, June 28, 1918, pp. 550-552, 5 figs. Describes the Loco-Tractor, a special form of machine to replace the locomotive on pioneer light railways; guide trucks on rails with driving wheels rubber-tired run on prepared strips of road metal on each side of the track.

Steel Cables (Hoisting Ropes)

Hoisting with Steel Cables. E. Levy. Western Eng., vol. 9, no. 8, August 1918, p. 315. Causes of breakage of ropes and suggested directions to the master mechanic.

Hoisting with Steel Cables. Ernest Levy. Min. & Sci. Press, vol. 117, no. 1, July 6, 1918, p. 21. Reasons for breaking; directions to master mechanics for care of ropes; warnings to hoistmen.

Life and Care of Hoisting Ropes. Coal Age, vol. 14, no. 1, July 6, 1918, pp. 11-13. Suggestions as to the best rope; when to renew ropes; recutting and re-coning ropes to change point of recurring stress.

Winding Drums

The Strength of Winding Drums. John S. Watts. Power, vol. 48, no. 4, July 23, 1918, pp. 127-128, 1 fig. Mathematical calculations of the safe strength of a shell of a drum to carry more than one coil of rope, such as the drum of a hoisting or winding engine.

Winding Engines (Electric)

Electric Deliveries for the "Black Diamond." A. Jackson Marshall. Elec. Rev., vol. 73, no. 2, July 13, 1918, pp. 70-71, 2 figs. Data on comparative cost of electric, gasoline and horse delivery of coal.

Electric Winding Engines and Mine Hoists. H. H. Broughton. Elecn., vol. 81, no. 10, July 5, 1918, pp. 206-209, 2 figs. First of a series. Describes scope of work and gives notes of general interest on the question of power supply.

Motor-Driven Shaft-Hoist Installation. Coal Age, vol. 14, no. 2, July 13, 1918, pp. 50-54, 7 figs.

35-Ton Wagon Hoist at Acklam Works. Iron & Coal Trades Rev., vol. 97, no. 2629, July 19, 1918, p. 67, 3 figs. Description of an electrically driven hoist.

Wire Ropes

The Factor of Safety of Wire Ropes Used for Winding in Mine Shafts. J. A. Vaughn. Jl. of the South African Inst. of Engrs., vol. 16, no. 11, June 1918, pp. 196-200, 1 fig. Author's reply to discussion of his original article published in issue of November 1917.

See also Coal Industry (Mine Conveying); Engineering Materials (Wire Rope); Power Plants (Ash Conveyors).

HYDRAULICS

Lindsay-Strathmore Irrigation Project. S. E. Kieffer. Eng. & Cement World, vol. 13, no. 3, August 1, 1918, pp. 13-17. Special features in connection with lining of flume and canal with the cement gun on a large irrigation project.

Dams

Design of a Tilting Dam. V. B. Siems. Can. Engr., vol. 35, no. 4, July 25, 1918, pp. 79-81. Details of construction of the Loch Raven Tilting Dam built on the Gunpowder River, to increase the water supply of Baltimore, Md. From paper read before the Am. Water Works Assn.

Repair Washout Under Dam by Sheet Pile Cutoff Embedded in Concrete. Eng. News-Rec., vol. 81, no. 4, July 25, 1918, pp. 186-189, 2 figs.

Reservoir Dams. Engineering, vol. 105, no. 2738, June 21, 1918, pp. 687-689, 18 figs. A description of the geologic and engineering features of the Howden and Derwent dams of the Derwent Valley Waterworks.

Hydroelectric Plants

Automatic Hydro-Electric Generating Station. L. B. Bennett. Page's Eng. Weekly, vol. 33, no. 722, July 12, 1918, p. 18. Description of the automatic generating station recently put into operation by the Iowa Ry. & Light Co.

Construction Problems at Copco Plant. Elec. World, vol. 72, no. 5, August 3, 1918, pp. 201-202, 3 figs. Account of construction of an hydroelectric installation on the Klamath River, Oregon.

Electric Power for Mining in Yavapai County, Arizona. Eng. & Min. Jl., vol. 105, no. 25, June 22, 1918, pp. 1113-1116, 2 figs. Description of the Irving and Childs hydroelectric plants of the Arizona Power Co., having a fall of 1600 ft. and operating 250 miles of lines.

Hydroelectric Development in Iron Mountain Region. Elec. Rev., vol. 72, no. 25, June 22, 1918, pp. 1027-1028, 5 figs. Brief description of some developments in Michigan.

Modern Development of Large Hydro-Electric Power Schemes. C. Fred. Holmboe. Elecn., vol. 81, no. 8, June 21, 1918, pp. 142-147, 11 figs. The initial investigation of conditions; three cheap waterpower developments in detail.

Kutter's Formula

Algae Growths Increase Value of n in Kutter's Formula. Paul Taylor. Eng. News-Rec., vol. 81, no. 4, July 25, 1918, pp. 179-181, 6 figs. Studies made in 1912-16 in Tieton irrigation canal lined with reinforced-concrete lock indicate that growths raise n from 0.012 to 0.014.

Siphons

Mine Siphon Practice. Compressed Air Mag., vol. 23, no. 8, August 1918, pp. 8848-8849. Conditions to be observed in the installation and operation of mine siphons. (From Coal Age.)

Waterwheel Repairs

Utilize Dry Season to Overhaul Waterwheels. C. A. Graves. Elec. World, vol. 72, no. 5, August 3, 1918, p. 203, 3 figs.

See also Power Plants (Steam Hydro-electric Plant).

INTERNAL-COMBUSTION ENGINEERING

Cylinder Walls

Thickness of Cylinder Walls of Light Internal Combustion Engines. Akimasa Ono. Jl. of the Soc. M. E., Tokyo, vol. 21, no. 52, June 1918, pp. 21-34, 2 figs. Application of the general approximate theory of a thin cylindrical wall deformed symmetrically about the axis to the case of a cylinder wall partially subjected to internal pressure.

Diesel Engines

Tar Oil Fuel for Diesel Engines. Petroleum World, vol. 15, no. 213, June 1918, pp. 234-235. Report of The Heavy-Oil Engine-Fuel Committee of the Diesel Engine Users' Assn., based on experimental comparisons of fuels. (Continued.)

The American Motorship "Oregon." Automotive Eng., vol. 3, no. 6, July 1918, pp. 266-270, 4 figs. Details of the construction of an American-built wooden ship equipped with two 650-hp. Diesel-type engines for main and auxiliary drives.

Werkspoor Marine Diesel Engines. Engineering, vol. 105, no. 2736, June 7, 1918, pp. 634-635, 7 figs. An illustrated description.

Heavy-Oil Engines

Rational Design for an Oil Engine. John F. Wentworth. Marine Rev., vol. 48, no. 8, August 1918, pp. 334-344, 8 figs. Study of the principles governing the selection of the different features in designing a marine oil engine and presentation of a design made according to the conclusions reached in the discussion.

The Heavy Oil Engine. Charles E. Lucke. Scientific Am. Supp., vol. 86, no. 2221, July 27, 1918, pp. 50-51. A review of the present construction and future development. Presented before the Engineers' Club of Philadelphia. (To be continued.)

The Heavy-Oil Engine from a Scientific Standpoint. Charles E. Lucke. Motorship, vol. 3, no. 8, August 1918, p. 24. (Concluded.)

Hvid Engine

Possibilities of the Hvid Engine. E. B. Blakely. Motorship, vol. 3, no. 8, August 1918, pp. 30-31. Requirements of the kerosene motor.

Ignition

Mechanical Construction of Ignition Magnetos. H. R. Van Deventer. Gas Eng., vol. 20, no. 8, August 1918, pp. 377-394, 26 figs. Paper read before a joint meeting of the National Gas Engine Assn. and the Soc. of Automotive Engineers, June 1918.

Low-Compression Engines

Some Features of Low-Compression Oil Engines. L. H. Morrison. Power, vol. 48, no. 4, July 23, 1918, pp. 123-127, 9 figs. Brief review of the principles of the two-stroke cycle type, various cylinder head designs, with their advantages and disadvantages, necessity for water injection, causes leading to scored cylinders.

Lubrication

Internal-Combustion Engine Lubrication and Lubricants. P. H. Conradson. Power, vol. 48, no. 3, July 16, 1918, p. 107. Abstract of paper read before the Am. Soc. for Testing Materials.

Lubrication and Fuel Economy. S. F. Lentz. Power Wagon, vol. 21, no. 165, August 1918, pp. 31-33. Conservation of motor fuel by the selection of a suitable lubricating oil. Paper read before the Nat. Gas. Eng. Assn.

Lubrication of Marine Heavy-Oil Engines. Motorship, vol. 3, no. 8, August 1918, pp. 9-15. Details of the leading types of lubricators.

Operating Costs

Operating Costs of Oil Engines. John Pierce. Power Plant Eng., vol. 22, no. 12, June 15, 1918, p. 504. Cost of fuel in cents per kw-hr. in one plant of about 2200 kw. capacity.

Sizes to Manufacture

The Number of Sizes of Engines to Manufacture. Theo. C. Menges. Nat. Gas Engine Assn. Bul., vol. 3, no. 12, July 1918, pp. 11-17. Curves showing the proportion of cubic feet of piston displacement, weight, cost and selling price, to the nominal horsepower of an engine. Paper read at the 11th annual meeting of the N. G. E. A. (To be continued.)

See also Aeronautics (Engines); Hoisting and Conveying (Loco Tractor).

IRON

(*See Steel and Iron*)

LABOR

British

British Railway Labor, Wages and Living Under Government Control. Ry. Rev., vol. 62, no. 24, June 15, 1918, pp. 863-867. Summary from report of railroad wage commission of phases of British railway experience.

Crippled Soldiers

The Return of the Crippled Soldier to Industrial Work. Am. Mach., vol. 49, no. 3, July 18, 1918, pp. 99-100. A discussion of the problem.

Housing Methods

Home Attractions Keep Track Laborers Satisfied. Clifford A. Elliott. Elec. Ry. Jl., vol. 52, no. 4, July 27, 1918, pp. 150-152, 4 figs. Solving the labor problem by providing free section houses with all conveniences, land for gardens and chicken raising, as well as free transportation to amusement places for employees and their families.

Man-Power Conservation

Conservation of Miners by Employment of Mechanical Equipment. R. L. Herrick. Coal Age, vol. 14, no. 4, July 25, 1918, pp. 162-167, 14 figs. Suggests many ways in which man power may be conserved by modern equipment.

Mutuality Plan

Oliver Iron Mining Co. Adopts Labor Coöperation Policy. Eng. & Min. Jl., vol. 105, no. 26, June 29, 1918, pp. 1166-1167. An account of the "mutuality" plan of the Oliver Iron Mining Co., establishing a medium whereby employees may make known their grievances and a mutual interchange of ideas may be brought about.

Physical Training

How Physical Training Helps Factory Executives. D. C. Stanbrough. Indus. Management, vol. 56, no. 1, July 1918, pp. 20-21, 2 figs.

Reading Rooms

Development of Santa Fe Reading Room System. Charles E. Parks. Ry. Age, vol. 65, no. 4, July 26, 1918, pp. 179-182, 10 figs. Reasons for its establisament; its activities and the good results that have been secured from it.

Schools

Coal-Mining Instruction in the Evening Schools of Derbyshire and Leicestershire. George Forster. Iron & Coal Trades Rev., vol. 97, no. 2628, July 12, 1918, pp. 34-35. Paper read before the South Midland Branch of the Nat. Assn. of Colliery Managers.

Training Men for the Shipyards. F. Forrest Pease. Am. Mach., vol. 49, no. 3, July 18, 1918, pp. 109-110. The experiences of the Shipping Board and suggestions as to how other industries may profit from them.

Training Men Instead of Stealing Them. Fred H. Colvin. Am. Mach., vol. 48, no. 25, June 20, 1918, pp. 1035-1039, 12 figs. Account of the training shop for developing skilled mechanics established by the Norton Grinding Co., Worcester, Mass.

Vestibule Schools for the Unskilled. H. E. Miles. Indus. Management, vol. 56, no. 1, July 1918, pp. 10-12. Shows how such schools are organized and gives results from those already in operation.

Turnover

Minimum Turnover in Machine-Shop Labor. Stanley H. Bullard. Iron Age, vol. 102, no. 4, July 25, 1918, pp. 204-206. Labor policy and wage classification plan of the Bullard Machine Tool Co. Results in output and *esprit*.

LIGHTING (ILLUMINATION)

Elements of Illuminating Engineering. Ward Harrison. Elec. Eng., vol. 52, no. 1, July 1918, pp. 37-39. Principles involved in the science of lighting buildings and public highways. (Continuation of serial.)

Artificial Daylight

A Precision Method for Producing Artificial Daylight. I. G. Priest. Physical Rev., vol. 11, no. 6, June 1918, pp. 502-504, 1 fig. Diagrams showing relative energy plotted against wave length of sunlight at the earth's surface and of light from a gas-filled tungsten lamp passed through a quartz plate 0.5 mm. thick between crossed nicol prisms, the path of the light being parallel to the optic axis of the quartz. Abstract of a paper presented before the Am. Phys. Soc.

Factories

How to Plan a Lighting Installation for a Factory. Elec. Rev., vol. 73, no. 2, July 13, 1918, pp. 49-52. Simple rules for contractor or lighting salesman for laying out the lighting system under average conditions, using standard reflectors and Mazda lamps.

Industrial Lighting for Shops. O. L. Johnson. Ry. Rev., vol. 62, no. 25, June 22, 1918, pp. 916-918, 2 figs. Some suggestions and "don'ts" for shop lighting.

Farm Buildings

Wiring of Farm Buildings for Lighting. Elec. Rev., vol. 73, no. 2, July 13, 1918, pp. 67-68, 1 fig. Chart for finding proper wire size for low-voltage lighting plants.

Meat-Packing Plants

Improved Lighting of Meat-Packing Plants. F. H. Bernhard. Elec. Rev., vol. 73, no. 3, July 20, 1918, pp. 87-92, 12 figs.

Textile Mills

Better Lighting of Textile Mills. F. H. Bernhard. Elec. Rev., vol. 72, no. 26, June 29, 1918, pp. 1070-1077, 10 figs. Better lighting to improve quality of product; lighting requirements of textile mills.

See also Electrical Engineering (Lamps).

LUBRICATION

See Air Machinery (Air Compressors); Internal-Combustion Engineering (Lubrication); Machine Tools (Lubrication); Motor-Car Engineering (Lubrication); Railroad Engineering, Steam (Lubrication); Testing and Measurements (Viscosity Measurement).

MACHINE PARTS

Bearings

Notes on Babbitt and Babbitted Bearings. J. L. Jones. Tran. Am. Inst. Min. Engrs., no. 140, August 1918, pp. 1395-1401, 5 figs. Results of tests performed at progressively increasing temperatures on bearing bronze and description of a process and a tool claimed to give smoother and more accurate surfaces to bearings than heretofore possible.

Crankshafts

Broken Crankshafts. Maurice M. Clement. Power Plant Eng., vol. 22, no. 14, July 15, 1918, pp. 564-565. Some causes and their prevention.

Gears

On Matsumura's Interchangeable Wheel Teeth (in Japanese). Tsuruzo Matsumura. Jl. of the Soc. M. E., Tokyo, vol. 21, no. 52, June 1918.

Reliable Gears. C. J. Brown. Coal Age, vol. 14, no. 3, July 20, 1918, pp. 99-100. Hardness and toughness for reliability accomplished by heat treatment of steel.

See also Mechanics (Helical Springs); Motor-Car Engineering (Springs).

MACHINE SHOP

Boring-Mill Operation

Time Studies for Rate Setting on Gisholt Boring Mills-I. Dwight V. Merrick. Indus. Management, vol. 56, no. 1, July 1918, pp. 34-41, 11 figs. The preparation of a boring mill for the work to be done. Seventeen tables give the necessary data, each table being devoted to a single operation.

Bulldozer Operation

Essentials of Bulldozer Operations—The V-Blocks. J. V. Hunter. Am. Mach., vol. 49, no. 5, August 1, 1918, pp. 195-199, 18 figs. Examples of operations on this machine.

Coloring, Lacquering and Finishing

Approved Practice in Coloring and Lacquering. James Steelman. Brass World, vol. 14, no. 6, June 1918, pp. 163-167, 9 figs. Oxidizing effects on silver; electric ovens.

Black and Steel Gray Finishes on Brass and Iron. Fred J. Liscomb. Brass World, vol. 14, no. 6, June 1918, pp. 159-161. Some objection to the "Rock Island" formulae; a consideration of the arsenic solution for steel-gray finish; lacquering.

Crankshaft Making

A California Jobbing Shop. Frank A. Stanley. Am. Mach., vol. 49, no. 3, July 18, 1918, pp. 121-123. Laying out, roughing down and finishing crankshafts for gasoline motors.

Die Casting

Die-Casting of Aluminum Bronze. H. Rix and H. Whitaker. Page's Eng. Weekly, vol. 32, no. 708, April 5, 1918, pp. 160-162. Process of die casting and factors affecting the future development of the industry.

Grinding

Cylindrical Grinding. W. D. Adamson. Machy. Market, no. 925, July 26, 1918, p. 21. Classification and description of internal-grinding machines. (Continued.)

Heat-Treating

The Electric Furnace for Heat-Treating. T. F. Baily. Am. Drop Forger, vol. 4, no. 7, July 1918, pp. 257-260, 3 figs. From a paper presented at the convention of the Am. Drop Forge Association.

Indian Shop

New Smith, Forge, Spring, Die Sinkers and Drop Forging Shops at Khargpur Works, Bengal-Nagpur Ry. Ry. Gaz., vol. 29, no. 1, July 5, 1918, pp. 18-22. Layout of buildings and equipment.

Pipe (Smokers') Making

The Making of a Smoker's Pipe. J. V. Hunter. Am. Mach., vol. 49, no. 3, July 18, 1918, pp. 93-98, 17 figs. Description of the manufacture of brier pipes.

Square (Gage Makers') Making

Making Accurate Squares for Gagemakers. John Teckeer. Am. Mach., vol. 48, no. 25, June 20, 1918, pp. 1041-1043, 10 figs. Describes methods by which a gage maker can produce his own squares.

See also Foundry (Welding; Sandblast); Marine Engineering (Welding); Steel and Iron (Heat Treatment).

MACHINE TOOLS

Boxing Machinery

Boxing Machinery to Prevent Damage. Luther D. Burlingame. Indus. Management, vol. 56, no. 1, July 1918, pp. 27-33, 18 figs. Practice of Brown & Sharpe Manufacturing Co. in packing machinery and tools for shipment.

Cost

The Rising Cost of Machine Building. Ludwig W. Schmidt. Am. Mach., vol. 49, no. 5, August 5, 1918, pp. 209-211.

Drills

Cable or Well Drills as Adapted to Blast Hole and Quarry. Eng. & Cement World, vol. 13, no. 2, July 15, 1918, pp. 60-66.

Choosing the Right Rock Drill. John F. Berteling. Mine & Quarry, vol. 10, no. 4, July 1918, pp. 1069-1073. A few instances of actual experience in fitting different types of drilling machines to various kinds of work.

Drill Bits and Drill Steel—Selecting, Forging and Tempering. George H. Gilman. Mine & Quarry, vol. 10, no. 4, July 1918, pp. 1075-1082, 18 figs. Present practice, specifications for straight-carbon hollow drill steel, details of the sharpening shop, and duties of the inspector regarding the tempering of drills.

Properties of Twist-Drills. B. W. Benedict and W. P. Lukens. Western Eng., vol. 9, no. 8, August 1918, p. 319. Conclusions drawn from an investigation of twist drills at the Engineers Experiment Station of the Univ. of Illinois. Abstract from Bul. No. 103 of the Eng. Experiment Station of the Univ. of Illinois.

Foreign Tariffs

Effect of Changes in Foreign Tariffs on the American Machine-Tool Industry. L. W. Schmidt. Am. Mach., vol. 48, no. 25, June 20, 1918, pp. 1047-1049.

Jigs and Fixtures

Templets, Jigs and Fixtures. Joseph Horner. Engineering, vol. 105, no. 2736, June 7, 1918, pp. 628-632, 50 figs. Fourth of a series, the present describing fixtures and jigs used in the manufacture of a radial drilling machine.

Lubrication

The Lubricating Problem. Raymond Francis Yates. Am. Mach., vol. 48, no. 25, June 20, 1918, pp. 1039-1040, 3 figs. Points out importance of lubricating machine tools.

Remanufacturing

Remanufacturing Machine Tools. Sibley Jl. of Eng., vol. 32, no. 11, August 1918, pp. 171-173, 4 figs. Offers solution to the problem of redistributing tools and of restoring them to their original condition of operation.

Toolroom

Toolroom Methods in a Pacific Coast Factory. Frank A. Stanley. Am. Mach., vol. 48, no. 25, June 20, 1918, pp. 1051-1055, 13 figs. Making of a varied line of punches, dies, jigs and fixtures; interesting presswork and tools.

MARINE ENGINEERING

Boilers

Corrosion of Marine Boilers. D. E. Rees. Am. Marine Engr., vol. 13, no. 7, July 1918, pp. 16-17. Suggestions in the care of marine boilers. From a paper read before the Inst. of Marine Engrs.

Cargo Ships

Standard Cargo Ships. Sir George Carter. Int. Mar. Eng., vol. 23, no. 7, July 1918, pp. 407-413, 6 figs. British practice in the design and construction of standard cargo ships. Paper read before the Inst. of Naval Architects, London, March 1918.

Cargo-Vessel Design

Longitudinal Framing and Diagonal Planking. J. R. Oldham. Nautical Gaz., vol. 93, no. 6, August 10, 1918, p. 65, 4 figs. A proposed bulk-cargo-vessel design.

Modern Shipbuilding and Economy in Material. Shipbuilding and Shipping Rec., vol. 11, no. 19, May 9, 1918, pp. 515-516, 3 figs. A series of comparisons between the transverse and longitudinal systems of framing wooden and steel ships. From a paper by J. W. Isherwood before the Soc. of Engrs.

The Relation of Speed to Dimensions in Merchant Ships. Shipbuilding & Shipping Rec., vol. 12, no. 3, July 18, 1918, p. 65. Experimental facts regarding the effects that details of construction of a ship have on speed.

Concrete Ships

Concrete Ship for the U. S. Shipping Board. Nauticus, vol. 1, no. 7, July 13, 1918, pp. 204-208. Specifications and com-

parative weights for a standard concrete ship given by the Emergency Fleet Corporation to the Committee of Commerce, U. S. Senate.

Construction of Concrete Ships for Emergency Fleet Corporation. R. J. Wig. Western Eng., vol. 9, no. 8, August 1918, pp. 306-307. Abstract of special report to Edward N. Hurley, chairman, U. S. Shipping Board, dated April 5, 1918.

Government Attitude on the Concrete Ship. Waldon Fawcett. Int. Mar. Eng., vol. 23, no. 7, July 1918, pp. 381-382.

The Big Concrete Ship Not Unreasonable. J. F. Springer. Int. Mar. Eng., vol. 23, no. 7, July 1918, pp. 383-386. A reply to Professor Everett's article on The Fallacy of Concrete Ship Construction.

Deep-Sea Diving

The Possibilities of Deep-Sea Diving. Robert G. Skerrett. The Rudder, vol. 34, no. 8, August 1918, pp. 370-374. Discusses pressures the human body is capable of withstanding.

Electric Power

Electricity's Part in Building and Navigating of Ships. H. A. Hornor. Elec. Eng., vol. 52, no. 1, July 1918, pp. 15-18. Electrical apparatus used in ships. (Continuation of serial.)

Electric Propulsion

Electrical Ship Propulsion. Am. Marine Engr., vol. 13, no. 7, July 1918, pp. 13-14. Study of the convenience in using an electric plant as a flexible gearing between the power generator and the propeller. From Engineering (London).

Fumigating Apparatus

Fumigating Apparatus for Shipyards and Emigrant Ships. Shipbuilding and Shipping Rec., vol. 12, no. 1, July 4, 1918, pp. 15-16, 1 fig. Apparatus constructed on the principle of the destruction of infection and of vermin by high-pressure dry-saturated steam which insures a temperature of 250 deg. fahr., thus destroying all germs without damaging or even wetting the goods.

Hog Island

Shipbuilding in the United States. Engineer, vol. 125, no. 3261, June 28, 1918, pp. 554-555, 18 figs. A description of the shipbuilding plant at Hog Island.

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Screw Propellers. D. W. Taylor. Shipbuilding and Shipping Rec., vol. 12, no. 1, July 4, 1918, pp. 35-39, 30 figs. Formulae and set of curves for the determination of the dimensions of screw propellers. (End of serial; previous articles appeared in vol. 10 (July-December 1917), pp. 55, 81, 223, 274, 464 and vol. 11, p. 469.)

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The Salvage of Deeply Sunken Ships. R. G. Skerrett. Scientific Am., vol. 119, no. 3, July 20, 1918, pp. 43-58. Engineering difficulties in salving a ship and account of some of the reports of the Salvage Department of the British Admiralty.

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Seattle Shipbuilders Overcome Pioneer Difficulties and Set New Speed Records. Claude A. Osier. Eng. News-Rec., vol. 81, no. 4, July 25, 1918, pp. 160-164, 8 figs. High-speed work in inadequate plant; persistent expediting of material; labor problems; two new machines used.

Ships' Hulls

Oil- and Water-tight Joints in Ships' Hulls. Evers Burtner. Int. Mar. Eng., vol. 23, no. 7, July 1918, pp. 404-406, 24 figs. Effective methods of securing water- and oil-tight joints in ships' structure under different conditions.

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American Merchant Marine Will Total 25,000,000 Tons in 1920. Edward N. Hurley. Int. Mar. Eng., vol. 23, no. 7, July 1918, pp. 379-381. Address by Chairman of U. S. Shipping Board at Univ. of Notre Dame, June 10, 1918.

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Explanation of the Several Methods of Expressing the Tonnage of Vessels. Sibley Jl. of Eng., vol. 32, no. 11, August 1918, pp. 170-171. Compiled from material supplied by the Chief of the Hull Drafting Department at the Harlan plant of the Bethlehem Shipbuilding Corp.

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Tonnage and Displacement Explained. The Rudder, vol. 34, no. 8, August 1918, pp. 388-391. (Continued from preceding issues.)

Welding, Electric

Electric Welding in Ship Work—A Rivetless Vessel. Times Eng. Supp., no. 525, July 1918, p. 149. Possibilities of extending the electric-welding system used in the building of a rivetless ship recently launched on the south coast of England and built in a shipyard operated by the Inland Waterworks and Docks Section of the Royal Engineers.

Wooden Ships

Revival of Wooden Ships. Nautical Gazette, vol. 93, no. 5, August 3, 1918, p. 52. Comparison between wooden and steel ships.

See also Internal-Combustion Engineering (Diesel Engines; Heavy Oil Engines); Power Generation (Electric Power Applications); Research (Marine Engineering).

MATHEMATICS

Differential Equations

Brief Synopsis of Differential Equations. N. W. Akimoff. Automotive Eng., vol. 3, no. 6, July 1918, pp. 247-250. Preliminary review of differential equations in their application to the study of oscillations.

Contribution to the Study of Oscillation Properties of the Solutions of Linear Differential Equations of the Second Order. R. G. D. Richardson. Am. Jl. of Mathematics, vol. 40, no. 3, July 1918, pp. 283-316.

Interpolation Properties of Orthogonal Sets of Solutions of Differential Equations. O. D. Kellogg. Am. Jl. of Mathematics, vol. 40, no. 3, July 1918, pp. 225-234. Types of boundary conditions and establishment of the property (*D*). Continued from No. 2. Presented to the Am. Mathematical Soc.

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P-Way Determinants, with an Application to Transvectants. Lepine Hall Rice. Am. Jl. of Mathematics, vol. 40, no. 3, July 1918, pp. 242-262. Definition of a determinant, formulated to remove the restriction in Cayley's law of multiplication and to set up a new case in Scott's law of multiplication; generalization to *P* dimensions of Metzler's theorem in two dimensions concerning a determinant, each of whose elements is the product of *k* factors.

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On the Numerical Solution of Integral Equations. E. T. Whittaker. Proc. of the Royal Soc., vol. 94, no. A662, June 1, 1918, pp. 367-383. Theoretical solutions of integral equations of the Abel and Poisson types.

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A Theorem on the Variation of a Function. Paul R. Rider. Bul. of the Am. Mathematical Soc., vol. 24, no. 9, June 1918, pp. 430-431.

On a Certain Functional Equation. Tsuruichi Hayashi. Science Reports of the Tôhoku Imperial University, vol. 7, no. 1, July 1918, pp. 1-32. Study of convex closed curves inscribable and revolvable in a polygon.

On a Certain General Class of Functional Equations. W. Harold Wilson. Am. Jl. of Mathematics, vol. 40, no. 3, July 1918, pp. 263-282. Contribution to systematize a general theory. Read before the Am. Math. Soc.

Theory of Functions (Théorie des fonctions). M. C. de la Vallée Poussin. Académie des Sciences, vol. 166, no. 21, May 27, 1918, pp. 843-846. Analytical investigation of the properties of the derivatives of some forms of trigonometric expressions.

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Volume Generated by the Rotation of a Spherical Contour (Sur les volumes engendrés par la rotation d'un contour sphérique). M. A. Buhl. Académie des Sciences, vol. 166, no. 22, June 3, 1918, pp. 896-897. Derivation of the general formula by the method of integral calculus.

MECHANICS

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Critical Loading of Struts and Structures. W. L. Cowley and H. Levy. Proc. of the Royal Soc., vol. 94, no. A662, June 1, 1918, pp. 405-422, 6 figs. Discussion of the stability of a prismatic homogeneous strut on simple supports, generalization of the equation of three moments, and study of the external loading due to wires in tension attached to a beam in the region of the supports.

Elastic-Strain Analogies

Transmission of Activation in Passive Metals as a Model of the Protoplasmic or Nervous Type of Transmission. Ralph S. Lillie. Science, vol. 48, no. 1229, July 19, 1918, pp. 51-60. Close analogies between the physico-chemical nature of nerve conduction and the electric current and inadequate comparison of nerve action to the transmission of mechanical influences such as elastic strain or vibration and to the propagation of explosive waves.

Helical Springs

Strength of Helical Springs. W. A. Atkinson. Mechanical World, vol. 63, no. 1637, May 17, 1918, pp. 234-235, 3 figs. Explanation of an accompanying table of maximum loads in pounds, and corresponding deflection per coil in inches of helical round steel wire springs.

Pipes, Curved

Stresses in Curved Pipes. J. S. Henzell. Mechanical World, vol. 64, no. 1644, July 5, 1918, p. 4, 2 figs. Analytical study of the effect of internal fluid pressure on curved pies. (To be continued.)

Shafts, Horizontal, Critical Speed

The Lower Critical Speed of Horizontal Shafts (in Japanese). Iwao Oki. Jl. of the Soc. M. E., Tokyo, vol. 21, no. 52, June 1918.

Sphere, Light, Movement in Air

On the Movement of a Light Spherical Ball in Air (Sur le mouvement d'une balle sphérique légère dans l'air). Paul Appell. Journal de Physique, vol. 7, March-April 1917, pp. 49-52. Remarks on Lord Rayleigh's article on the irregular flight of a tennis ball, published in the Messenger of Mathematics, no. 73, 1877.

Steel Columns

Recommended Unit-Stresses in Steel Columns and Struts. Western Eng., vol. 9, no. 8, August 1918, p. 312. Diagram showing stresses recommended for different values of l/r both by the Am. Ry. Eng. Assn. formula and by the formula recommended by a special committee of the Am. Soc. C. E.

See also Engineering Materials (Glass); Power Plants (Piping).

METAL ORES

Crushing Resistance

Crushing Resistance of Various Ores. L. W. Lennox. Trans. Am. Inst. Min. Engrs., no. 140, August 1918, pp. 1255-1264, 10 figs. Account of tests and summary of results.

Lead

Mineralogy of Ores. H. L. Payne. Min. and Oil Bul., vol. 4, no. 8, July 1918, p. 339. Information concerning the ores of lead: galenite, cerussite, anglesite, crocoite. (Continuation of a serial.)

Mercury

Note on Extraction of Mercury from Its Ores by Sodium Sulphide. C. H. Holland. New Zealand Jl. of Science & Technology, vol. 1, no. 3, May 1918, pp. 153-154. Report of experiments and description of method.

Molybdenum

Molybdenite Operations at Climax, Colorado. D. F. Haley. Trans. Am. Inst. Min. Engrs., no. 140, August 1918, pp. 1183-1188. Geology, mining system and marketing of the deposit.

Pyrites

Pyrite Deposits of Leadville, Colo. H. S. Lee. Trans. Am. Inst. Min. Engrs., no. 140, August 1918, pp. 1223-1229. Geology, occurrence of the ore, method of mining it and its value in the manufacture of sulphuric acid.

Radium

Radium. Richard B. Moore. Trans. Am. Inst. Min. Engrs., no. 140, August 1918, pp. 1165-1182. History, disintegration series, ore deposits, metallurgical treatment, methods of ore concentration, supply of ore, substitute for and uses of radium.

Spelter

Spelter Statistics for 1917. W. R. Ingalis. Eng. & Min. Jl., vol. 106, no. 4, July 27, 1918, pp. 176-181.

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Recently Recognized Alunite Deposits at Sulphur, Humboldt County, Nevada. I. C. Clark. Eng. & Min. Jl., vol 106, no. 4, July 27, 1918, pp. 159-163, 5 figs.

Tungsten

Molybdenum, Tungsten and Bismuth. Indus. Australian & Min. Standard, vol. 59, nos. 1544 and 1546, June 13 and 27, 1918, pp. 623-624, 688-689; vol. 60, no. 1547, July 4, 1918, pp. 29-30, 1 fig. Treatise on these minerals dealing with the general character, associated metallic minerals and geological features of their ores. (To be continued.)

Tungsten Ore Deposits Near Falcon Lake, Manitoba. Justin S. DeLury. Can. Min. Jl., vol. 39, no. 11, June 1, 1918, pp. 186-188, 6 figs. Map of area and brief description of its geology.

Tungsten Ores in Southern Rhodesia. H. B. Maufe. South African Min. Jl. & Eng. Rec., vol. 27, part 2, no. 1390, p. 61. Abstract from Report No. 4 of the Southern Rhodesia Geological Survey.

Vein Formation

The Mechanics of Vein Formation. S. Taber. Trans. Am. Inst. Min. Engrs., no. 140, August 1918, pp. 1189-1222, 5 figs. Methods of vein formation.

See also Engineering Materials (Tungsten).

METALLURGY

Baghouses

Baghouses for Zinc Oxide. John F. Cregan. Eng. & Min. Jl., vol. 106, no. 3, July 29, 1918, pp. 126-132, 7 figs. Further improvement and standardization in design essential.

Blast Furnaces

Copper Tuyeres for Blast Furnaces. A. K. Reese. Blast Furnace & Steel Plant, vol. 6, no. 8, August 1918, pp. 329-330, 2 figs. Results obtained with copper tuyeres and considerations on their adoption. Paper read before the British Iron & Steel Inst.

Principal Changes in Blast Furnace Lines. J. G. West. Blast Furnace & Steel Plant, vol. 6, no. 8, August 1918, pp. 323-329, 56 figs. Discussion of theoretical lines and account of the development of the hearths. (Continued.)

Copper Refining, Electrolytic

New Cornelia Copper Company's Plant a Success. R. B. Leach. Min. and Oil Bul., vol. 4, no. 8, July 1918, pp. 315-328, 4 figs. Layout of buildings and description of processes followed by a plant said to produce 80 lb. of pure electrolytic copper per min.

Cyanide Process

Charcoal Precipitation of Gold in Cyanide Solutions. Chem. Eng. & Min. Rev., vol. 10, no. 118, July 1918, pp. 309-310. Comments on a paper describing the Moore-Edmands process, as installed at the Yuannii mine, W. A., published in the issue of November 1917.

Effect of Oxygen Upon the Precipitation of Metals from Cyanide Solutions. T. B. Crowe. Trans. Am. Inst. Min. Engrs., no. 140, August 1918, pp. 1279-1282. Effect of vacuum precipitation on consumption of cyanide and opposing action of oxygen and hydrogen.

Fine-Grinding Cyanide Plant of Barnes-King Development Co. J. H. McCormick. Trans. Am. Inst. Min. Engrs., no. 140, August 1918, pp. 1283-1291, 4 figs. Description of the operations in the mine.

Roasting for Amalgamating and Cyaniding Cripple Creek Sulphotelluride Gold Ores. A. L. Bomfield and M. J. Trott. Trans. Am. Inst. Min. Engrs., no. 140, August 1918, pp. 1265-1278, 2 figs. Classification of ores, chemical reactions in roasting and rapid methods of analysis for sulphur in ores.

Recent Progress

Notes on Recent Metallurgical Progress. E. P. Mathewson. Eng. & Min. Jl., vol. 106, no. 3, July 20, 1918, pp. 138-145, 3 figs. Impressions received during a journey of observation among the great smelteries of the United States, with practical comments on design and operation.

Rolling Alloy Strips

New Installation for Rolling Alloy Strips. Blast Furnace & Steel Plant, vol. 6, no. 8, August 1918, pp. 819-821. Process of the Nat. Pressed Steel Co., Massillon, Ohio.

Silver-Lead Smeltery

Ideal Layout for Silver-Lead Smeltery. Guy C. Riddell. Eng. & Min. Jl., vol. 106, no. 3, July 20, 1918, pp. 115-122, 3 figs. Details of a plant for a 100- to 3000-ton daily charge.

Slag, Open-Hearth, Basic

Utilization of Basic Open Hearth Slag. Blast Furnace & Steel Plant, vol. 6, no. 8, August 1918, p. 322. Account of the progress of this industry in England. From Jl. Soc. Chem. Industry.

See also Aeronautics (Materials of Construction).

MILITARY ENGINEERING

Ballistics

Internal Ballistics. Engineer, vol. 125, no. 3258, June 7, 1918, p. 490. Abstract of a lecture by Lieut-Col. A. G. Hadcock delivered at the Royal Inst.

Planetary Ballistics

Planetary Ballistics (De balistica planetaria). Madrid Cientifico, year 25, no. 956, June 5, 1918, pp. 281-283. Mathematical investigation of the range of a projectile in terms of its initial velocity and the angle of projection.

Gun Erosion

Gun Erosion. Engineering, vol. 105, no. 2736, June 7, 1918, p. 640. Discusses H. M. Howe's views on the hardening of the gun bore, reasons for cracking, and suggests a remedy for erosion troubles. Abstract of a paper read by H. C. H. Carpenter before the Inst. of Naval Engrs.

Military Training

Army Engineer School in France Standardizes Work in the Field. Robert K. Tomlin, Jr. Eng. News-Rec., vol. 81, no. 3, July 18, 1918, pp. 112-117, 13 figs. Course of training for men recommended for commissions; classes trained in mining, pioneering, bridging, topography, camouflage, sound ranging and interpretation of aerial photographs.

Training Mechanics for Service in Army Field Units. J. V. Hunter. Am. Mach., vol. 49, no. 4, July 25, 1918, pp. 163-167, 13 figs. Methods employed in training drafted men for the needs of the Army.

Torpedoes

Moving Targets and Torpedo Attack. Engineer, vol. 125, no. 3261, June 28, 1918, pp. 561-563, 14 figs. A mathematical consideration.

See also Munitions.

MINES AND MINING

Cementation and Concreting

Cementation in the Illinois Oil Field. M. L. Nebel. Eng. & Min. Jl., vol. 105, no. 24, June 15, 1918, pp. 1080-1082, 1 fig. Use of cement, excluding water, to increase immediate production and probably total extraction, also lower operating costs.

Notes on Shaft Relining With Concrete. G. G. Stonemark. Eng. & Min. Jl., vol. 106, no. 1, July 6, 1918, pp. 8-10. Methods used in two Minnesota shafts.

Cementing

Stripping and Relining a Shaft at Cowdenbeath, Fife. Henry Rowan. Queensland Government Min. Jl., vol. 19, no. 217, June 15, 1918, pp. 266-267. From a paper read before the Min. Inst. of Scotland.

Electrical Operation

Earthing Electrical Services in Mines. Colliery Guardian, vol. 116, no. 3002, July 12, 1918, pp. 70-71. Necessity of a good earth contact; the ideal earth.

The Safe Operation of Power Plant Switchboards. L. Fokes. Colliery Guardian, vol. 116, no. 3001, July 5, 1918, pp. 17-18, 8 figs. Safe methods of handling electricity in mines.

Mine Surveying

The Future Aspect of Mine Surveying. John Proctor. Colliery Guardian, vol. 116, no. 3003, July 19, 1918, pp. 121-122. Influence of magnetic declination, extraneous objects and electricity on surveys; description of methods adopted; necessity for accuracy.

Oil

Methods of Increasing the Recovery from Oil Lands. J. O. Lewis. Automotive Eng., vol. 3, no. 6, July 1918, pp. 274-277. Suggested ways in which it is claimed more crude oil can be obtained from any given oil field. (Concluded.)

Sand Filling

Notes on Sand Filling in Mines. C. H. Greathead. Colliery Guardian, vol. 116, no. 3003, July 19, 1918, p. 125.

Ventilation

Canvas Tubing for Mine Ventilation. Lester D. Frank. Queensland Government Min. Jl., vol. 19, no. 217, June 15, 1918, pp. 249-251, 4 figs. Manner in which canvas tubing is being used in the North Butte Company's mines at Butte, Mont. Abstract from Bul. A. I. M. E., February 1918.

MOTOR-CAR ENGINEERING

British Motors

The Industrial Motor. Motor Traction, vol. 27, no. 696, July 3, 1918, pp. 1-2. The products of the British motor industry reviewed and classified according to their respective uses. (Continuation of serial.)

Electric Vehicles

The Electric Vehicle Committee. Motor Traction, vol. 27, no. 696, July 3, 1918, pp. 14-15. Annual report for the year ended March 31, 1918.

War Time Uses of Industrial Electric Trucks. Elec. Rec., vol. 24, no. 2, August 1918, pp. 57-67. Uses of electric trucks and specifications of the different types.

Electrical Equipment

Ignition, Starting, Generating and Lighting System on Automotive Vehicles. C. L. White. Auto and Tractor Shop, vol. 17, no. 10, July 1918, pp. 240-241, 4 figs. Elementary facts and principles of ignition; connection of batteries; make-and-break ignition systems.

Lighting Generators and Starting Motors for the Automobile. Elec. Rec., vol. 24, no. 2, August 1918, pp. 68-73. Features of modern designs of lighting generators and starting motors and outline of their necessary auxiliary devices.

The Care and Repair of Automobile Starting and Lighting Batteries. Auto and Tractor Shop, vol 17, no. 10, July 1918, pp. 244-246, 3 figs. Remarks and suggestions. (To be continued.)

The Testing of British-Made Magnetos. H. M. Buist. Autocar, vol. 41, no. 1186, July 13, 1918, p. 44. Suggestions resulting from a visit of the author to a number of British magneto factories.

Lubrication

A New Chassis Lubrication System. Automotive Industries, vol. 39, no. 3, July 18, 1918, pp. 95-96, 4 figs. Scheme by which oil is fed to bearings by wicks and quantity fed is regulated by localized compression of the wicks.

Motor Buses

The Industrial Motor. Motor Traction, vol. 27, no. 696, July 3, 1918, pp. 1-2. Capabilities and costs of public-service vehicles. (To be continued.)

Speedometers

Speedometers and How to Care for Them. L. W. Burchinal. Auto and Tractor Shop, vol. 17, no. 10, July 1918, pp. 249-250, 5 figs. Principle of operation of each one of the four different types of speedometers; forms of speedometer cables; method of attaching speedometer sprockets and swivel joint to the front wheel of an automobile.

Springs

The Spring of the Car. F. M. Paull. Auto and Tractor Shop, vol. 17, no. 10, July 1918, pp. 255-256, 9 figs. History of the introduction of springs in the manufacture of vehicles and review of the principles involved in their use.

Tires

A New South African Tire. The Autocar, vol. 40, no. 1184, June 29, 1918, p. 631, 1 fig. Features of a new casing claimed to be of advantage on deeply rutted roads.

Tractors

Economical Sizes of Tractors. Ernest Goldberger. Power Wagon, vol. 21, no. 165, August 1918, pp. 53-54, 2 figs. Record of the performances of tractors in different kinds of work

Soil Resistance and the Tractor. Fred. M. Loomis. Motor Age, vol. 34, no. 3, July 18, 1918, pp. 20-23. Rules to figure drawbar pull and to determine the size of machine needed.

The Oil-Burning Tractor Engine. H. T. Sward. Automotive Eng., vol. 3, no. 6, July 1918, pp. 265-266. Development and special requirements of the oil-burning tractor. Paper read before the joint meeting of the Chicago Section of the Soc. of Automotive Engrs. and the Nat. Gas. Eng. Assn. in Chicago, Ill.

Trucks

Applying Engineering Principles in the Design of Trucks. Norman Litchfield. Elec. Ry. Jl., vol. 52, no. 3, July 20, 1918, pp. 109-111, 2 figs. Eight points to consider; the calculation of the stresses.

Chassis Design of Class B Trucks. Cornelius T. Myers. Power Wagon, vol. 21, no. 165, August 1918, pp. 41-44, 2 figs. Account of the specifications and details of design adopted at the Quartermaster General's Office.

Measuring Motor Truck Ability. Francis W. Davis. Power Wagon, vol. 21, no. 165, August 1918, pp. 26-28. Suggested technical method for determining the hill-climbing ability of a motor truck.

Motor Trucks Build Roads. Good Roads, vol. 16, no. 5, August 3, 1918, pp. 44-45. Machines utilized to haul graders in various localities.

See also Internal-Combustion Engineering (Cylinder Walls).

MUNITIONS

Anti-Aircraft Guns

The Three-Inch Anti-Aircraft Gun, Model 1918. Am. Mach., vol. 49, no. 5, August 1, 1918, pp. 185-190, 5 figs.

Canadian Shell Plant

Canadian National Steel Plant. W. F. Sutherland. Can. Machy., vol. 20, no. 4, July 25, 1918, pp. 75-81. Illustrated article describing the steel plant operated by the Imperial Munitions Board for the British Government.

Chemistry and Metallurgy

The Chemist and Metallurgist in the Munitions Industry. F. E. Gardiner. Can. Machy., vol. 20, no. 4, July 25, 1918, pp. 98-103. Work of the chemist and of the metallurgist in munition factories.

French Field Gun

The Development of the French 75-mm. Field Gun. J. A. Lucas. Am. Mach., vol. 49, no. 4, July 25, 1918, pp. 149-152, 11 figs. The invention, construction and operation during the years of its use.

Hand Grenades

Some Types of Modern Hand Grenades. Rudolph C. Lang. Am. Mach., vol. 49, no. 4, July 25, 1918, pp. 139-143, 11 figs. A history of the hand grenade and a description of various types now in use.

Rapid-Fire Guns

The Madsen Gun. Engineer, vol. 125, no. 3258, June 7, 1918, pp. 495-498, 6 figs. Details of the new automatic small-arm which depends for its action on the recoil of the barrel.

Shell Production

Efficient Appliances for Economic Shell Production. J. H. Rodgers. Can. Machy., vol. 20, no. 4, July 25, 1918, pp. 104-108, 8 figs. Illustrations indicating a number of accessories that have been instrumental in the manufacture of the various shells.

Great New Jersey Shell-Loading Plant. Committee on Public Information. Am. Mach., vol. 49, no. 3, July 18, 1918, pp. 125-130, 8 figs. Description of a plant turning out 52,000 loaded shells per day.

How Dummy Iron Shells Are Molded and Cast. H. Cole Estep. Foundry, vol. 46, no. 312, August 1918, pp. 347-350, 6 figs. Two-part flask employed with most of mold in cope; special gating arrangements necessary.

Specifications for Semisteel Projectiles. Foundry, vol. 46, no. 312, August 1918, pp. 345-346. Refers to cast semi-steel projectiles, experiments upon which have proven satisfactory enough to warrant ordering 500,000.

See also Air Machinery (Shell Plant).

PHYSICS

Acoustics

The Influence of Amplitude and of Electromagnetic Driving on the Frequency of Tuning Forks. D. C. Miller. Physical Rev., vol. 11, no. 6, June 1918, pp. 497-498, 2 figs. Results of an investigation of the frequency of tuning forks conducted with the Koenig Clock-Fork. Abstract of paper presented before the Am. Phys. Soc.

Electricity

On the Formation of Negatively Electrified Rain Drops. F. Sanford. Physical Rev., vol. 11, no. 6, June 1918, pp. 445-448, 1 fig. Negatively electrified drops may be blown from positively electrified drops by a wind which regularly gives off positive charges to water.

The Air-Damped Vibrating System: Theoretical Calibration of the Condenser Transmitter. I. B. Crandall. Physical Rev., vol. 11, no. 6, June 1918, pp. 449-460, 8 figs. Mechanical theory of the Wente's condenser transmitter; mechanism of air-dampening and formulae for practical calculations. Paper read before Am. Phys. Soc.

The New Thermo-Electric Effect (Le nouvel effect thermo-électrique). M. Carl Benedicks. Revue de Métallurgie, year 15, no. 3, May-June 1918, pp. 329-332, 3 figs. Outline of experiments demonstrating that differences in temperature establish an electric current in a homogeneous metallic circuit.

Expansion of Metals

Expansion of Metals by Heat. John Roger. Western Eng., vol. 9, no. 8, August 1918, p. 316. Table of coefficients of expansion of metals by equal units of temperature and by equal units of energy, and of other physical properties of these substances.

Ions

On the Possibility of Tone Production by Rotary and Stationary Spark Gaps (in Japanese). H. Yagi. Denki Gakkwai Zasshi, no. 353, January 19218, pp. 105-131.

Liquids

Why Water Overfills a Tumbler. Will H. Coghill and Carl O. Anderson. Scientific Am. Supp., vol. 86, no. 2221, July 27, 1918, pp. 52-53, 3 figs. Study of flotation in its connection with the metal-mining industry.

Luminescence

The Photo-Luminescence and Katho-Luminescence of Calcite. E. L. Nichols, H. L. Howes and D. T. Wilber. Physical Rev., vol. 11, no. 6, June 1918, pp. 485-486. Experiments showing that calcites of the Franklin Furnace variety when subjected to kathode bombardment exhibit phosphorescence of the type hitherto supposed to be peculiar to the uranyl salts. Abstract of a paper presented before Am. Phys. Soc.

Meteorology

Cooling of the Lower Regions of the Atmosphere During the Night. (Sur le refroidissement nocturne des couches, basses de l'atmosphère). Henri Perrotin. L'Aérophile, year 26, no. 9210, May 15, 1918, p. 136. Calculation of the radiation coefficients of the atmosphere at different levels from measured temperature values.

On the Times of Sudden Commencement of Magnetic Storms. S. Chapman. Phys. Soc. of Lond., vol. 30, part 4, June 15, 1918, pp. 205-214. Discussion of the question as to how far magnetic storms commence simultaneously at different parts of the earth, based on the data collected by Bauer for 15 magnetic storms.

Optics

A Theory of Color Vision and the Selective Action of the Eye. R. A. Houston. Scientific Am. Supp., vol. 86, no. 2223, August 10, 1918, pp. 92-93, 10 figs. A non-mathematical account of a theory described in the Proc. Royal Soc., A92, p. 424, 1916. From Science Progress.

Absorbing Power of the Earth's Atmosphere (Contribution a l'étude du pourvir absorvant de l'atmosphere terrestre). M. A. Boutaric. Annales de Physique, vol. 9, March-April 1918, pp. 113-203, 28 figs. Beginning of an extensive report of observations on the light-absorbing power of the atmosphere and a study of its bearing on the proportion of polarized light diffused by the sky.

Discussion on Visible and Invisible Rays (in Japanese). Denki Gakkwai Zassai, no. 359, June 30, 1918. Paper read before the meeting of Kwansai Local Section.

Limit of Sensibility of the Eye and Minimum Value of Radiant Energy Which Can Be Perceived Visually (La limite de sensibilité de l'oeil et le minimum de puissance perceptible visuellement). H. Buisson. Journal de Physique, vol. 7, March-April 1917, pp. 68-74. Account of the methods followed by Langley, Drude, Russell and Reeves for evaluating the least mechanical power which can be perceived visually.

On Tracing Rays Through an Optical System. T. Smith. Phys. Soc. of Lond., vol. 30, part 4, June 15, 1918, pp. 221-233, 1 fig. Modification of the formulae for rays in an axial plane published by the author in Proc. Phys. Soc., vol. 27, p. 502, and outline of method followed in calculations relating to the transverse focal lines.

Photograph of an Aurora Model. C. C. Trowbridge. Physical Rev., vol. 11, no. 6, June 1918, pp. 482-483. Description of photographs of a large model of the aurora constructed to study the optical effects of perspective. Abstract of a paper presented before the Am. Phys. Soc.

The Law of Symmetry of the Visibility Function. I. G. Priest. Physical Rev., vol. 11, no. 6, June 1918, pp. 498-502, 1 fig. Deductions from an attached diagram showing the relative visibility of radiant power plotted against wave-length as abscissae. Abstract of a paper presented before the Am. Phys. Soc.

Transparency of Certain Carbon Compounds to Waves of Great Length. H. P. Hollnagel. Physical Rev., vol. 11, no. 6, June 1918, p. 505. Transparency of quartz, benzene, carbon bisulphide and other substances to residual rays of rock salt ($\lambda = 52\ \mu$). Abstract of Am. Phys. Soc. paper.

Visible and Invisible Rays (in Japanese). M. Kimura. Denki Gakkwai Zasshi, no. 254, January 1918, pp. 87-97.

Oscillatory Phenomena

An Harmonic Synthesizer Having Components of Incommensurable Period and Any Desired Decrement. W. J. Raymond. Physical Rev., vol. 11, no. 6, June 1918, pp. 479-481. Apparatus constructed by the mechanician of the Department of Physics of the Univ. of California which serves to draw continuous curves showing graphically the characteristics of complex harmonic motions. Abstract from paper presented before the Am. Phys. Soc.

Variation of Velocity of Waves Due to Motion of the Source. D. Alter. Physical Rev., vol. 11, no. 6, June 1918, pp. 481-482. Generalization of the mathematical theory which asserts that the velocity of sound depends upon the velocity of the source as well as upon the kind of medium of propagation of waves. Abstract of paper presented before the Am. Phys. Soc.

Precipitation

Electrostatic Precipitation. O. H. Eschholz. Tran. Am. Inst. Min. Engrs., no. 140, August 1918, pp. 1293-1306, 11 figs. Present extension of the electrostatic process of fume precipitation; essential features of this system.

Recent Progress

Notes on Recent Progress in Physics (Quelques récents progrès de la Physique). Leon Bloch. Revue Générale des Sciences, year 20, no. 7, April 15, 1918, pp. 198-208. Résumé of recent researches in advanced laboratory work.

Solutions

A Method for the Quantitative Study of Gases in Metals. H. M. Ryder. Physical Rev., vol. 11, no. 6, June 1918, p. 486. Abstract of paper presented before the Am. Phys. Soc.

Solutions of Gases in Liquids (Les solutions des gaz dans les liquids). M. Felix Michaud. Annales de Physique, vol. 9, March-April 1918, pp. 203-232. Beginning of a proposed thorough revision of the theory of gas solutions.

Spectrum

Methyl-Violet as a Red-Sensitiser of the Photographic Plate. Usuburo Yoshida.

Memoirs of the College of Science, Kyoto Imp. Univ., vol. 3, no. 3, April 1918, pp. 69-71, 4 figs. Account of experiments.

The Effect of an Electric Field on the Spectrum Lines of Helium. T. Takamine and N. Kokubu. Memoirs of the College of Science, Kyoto Imp. Univ., vol. 3, no. 3, April 1918, pp. 81-92, 10 figs. Results obtained from investigations relating mainly to the more refrangible lines of helium. (Continued.)

The Reversal of Spectrum Lines Produced by a Spark Under Water. Toshikazu Mashimo. Memoirs of the College of Science, Kyoto Imp. Univ., vol. 3, no. 3, April 1918, pp. 73-79, 1 fig. Result of experiments performed with the view of following the investigations of Konen, Lockyer, Hale and Finger regarding the reversal of lines in the different regions of the spectrum.

Wave-Lengths of the Tungsten X-Ray Spectrum. Elmer Dershem. Physical Rev., vol. 11, no. 6, June 1918, pp. 461-476, 6 figs. Resolving power of a crystal used as a diffraction grating for X-rays; methods of applying the theories concerning resolving power, description of apparatus used in securing the X-ray spectrum; tabulation of experimental results; theoretical considerations.

Structure of Matter

Atomic and Molecular Numbers. Herbert Stanley Allen. Jl. of the Chem. Soc., vols. 113 and 114, no. 667, May 1918, pp. 389-396. Present value of the atomic weight in face of the recent investigations in connection with radioactive elements.

Note on the Weiss Molecular Field in Ferromagnetic Substances. Kôtarô Houda. Science Reports of the Tôhoku Imperial Univ., vol. 7, no. 1, July 1918, pp. 53-58. Comments on Weiss' assumption that if a ferromagnetic substance undergoes the action of an external field, each molecule is in addition subjected to the action of a large field in the direction of the external field.

On the Relation Between the K X-Ray Series and the Atomic Numbers of the Chemical Elements. W. Duane and Kang-Fuh Hu. Physical Rev., vol. 11, no. 6, June 1918, pp. 488-489. Result of measurements of critical absorption frequencies from manganese ($N=25$) to cerium ($N=38$), all measured with the same apparatus. Abstract of a paper presented before the Am. Phys. Soc.

Radiation and the Electron. R. A. Millikan. Scientific Am. Supp., vol. 86, no. 2221, July 27, 1918, pp. 60-61, 2 figs. Suggestions for solving the problem of the transmission of light through interstellar space. Article presented at the meeting of the Section of Physics and Chemistry of the Franklin Institute. (To be continued.)

The Electromagnetic Inertia of the Lorentz Electron. G. A. Schott. Proc. of the Roy. Soc., vol. 94, no. A662, June 1, 1918, pp. 422-436. Remarks on G. W. Waker's paper on The Effective Inertia of Electrified Systems Moving with High Speed, in Proc. Roy Soc., A, vol. 93, p. 448, 1917.

The Entropy of a Metal. H. S. Allen. Phys. Soc. of Lond., vol. 30, part 4, June 15, 1918, pp. 215-220, 1 fig. Discussion of the hypotheses assumed in the theory of Ratnowsky and examination of the latter's expression for the entropy of one gram-atom of a substance in the solid state in view of the values obtained by Lewis and Gibson.

The Resonance and Ionization Potentials for Electrons in Thallium Vapor. P. D. Foote and F. L. Mohler. Physical Rev., vol. 11, no. 6, June 1918, pp. 486-487. Account of experiments and interpretation of results obtained. Abstract of paper presented before the Am. Phys. Soc.

POWER GENERATION AND SELECTION

Canada

Availability of Energy for Power and Heat. J. Blizard. Jl. Eng. Inst. of Can., vol. 1, no. 3, July 1918, pp. 112-115. Outline of the sources of energy supply in Canada and of the requirements they meet.

Electric-Power Applications

Application of Electricity in the Modern Navy in the World (in Japanese). T. Minohara. Denki Gakkwai Zasshi, no. 356, March 31, 1918.

Electric Plant at a Canadian Smelting Works. Engineer, vol. 126, no. 3263, July 12, 1918, pp. 24-26, 2 figs. Description of an hydraulic and a steam plant.

Electric Power Supply in the Future. Engineer, vol. 125, no. 3258, June 7, 1918, pp. 498-499. Report of the Committee appointed by the Board of Trade to consider steps to be taken to insure an adequate supply of electric power for all classes of consumers.

Electrically Operated Quarry and Rock Crushing Plant in Chicago. Elec. Rev., vol. 72, no. 26, June 29, 1918, pp. 1067-1069, 7 figs. Electric power applied to drills, haulage, crushers and screens.

Electricity in Agriculture. Elec. Times, vol. 54, no. 1394, July 4, 1918, pp. 19-20, 3 figs. Some notes on electric plowing in France.

Electricity in Coal-Mining Operations. Frank Huskinson. Elec. Rev., vol. 73, no. 1, July 6, 1918, pp. 1-4, 9 figs. Factors governing selection of electrical equipment; comparisons of alternating and direct current; advantages of central-station service.

Motor Drive in Newburgh Shipyard. W. H. Easton. Elec. World, vol. 72, no. 4, July 27, 1918, pp. 160-161, 6 figs. Standard types chosen to insure prompt delivery; individual motor drive selected for speeding output; foolproof equipment permits use of unskilled labor.

Motor Drive in Paper and Pulp Mills. C. E. Clewell. Elec. World, vol. 72, no. 4, July 27, 1918, pp. 152-154, 5 figs. Important applications, particularly beaters and grinders; variations on power requirements; examples of group and individual drive. First of a series.

Opportunities for Central-Station Power in the Oil Fields. L. E. Mohrhardt. Elec. Rev., vol. 73, no. 1, July 6, 1918, pp. 7-11, 7 figs. Application of electric power to the various operations involved and data on horsepower requirements.

See also Forging (Electric Power); Hydraulics (Hydroelectric Plants); Marine Engineering (Electric Power).

POWER PLANTS

Ash Conveyors

Economic Handling of Ashes. Reginald Trautschold. Indus. Management, vol. 56, no. 1, July 1918, pp. 17-20, 4 figs. Suction and steam jet conveyors, bucket carriers, and ash cars. Description of latest developments in ash-handling apparatus and approximate handling cost per ton.

Suction Conveyors for Ashes. R. Trautschold. Compressed Air Mag., vol. 23, no. 8, August 1918, pp. 8843-8845. Mechanical method of accomplishing the ash-handling task. From Indus. Management.

Automatic Stokers

Modern Plant of Paris Medicine Co. Power Plant Eng., vol. 22, no. 13, July 1, 1918, pp. 519-523, 7 figs. Illustrated description of a 100-kw. plant having automatic stokers.

Boiler House

Boiler Settings—Multiple Retort Underfeed Stokers. Charles H. Bromley. Power, vol. 48, no. 4, July 23, 1918, pp. 112-117, 9 figs. The latest and best practice in boiler settings for the multiple retort underfeed stoker. The problem of burning high-volatile and high-ash coals.

Improving Boiler-room Operation. I. L. Kentish-Rankin. Elec. Rev., vol. 72, no. 24, June 15, 1918, pp. 986-989. Bettering performance by standard improved methods and indicating instruments.

The Maintenance of Economy in the Boiler House. D. Wilson. Elecn., vol. 81, no. 9, June 28, 1918, pp. 169-171. The importance of regular and detailed records. The transmission of heat. The sampling and testing of coal with a view to accuracy. Routine desirable in regard to the control of flue gases and combustible in ashes.

Chimneys

Calculations of Sheets for Tapered Stack. John A. Cole. The Boiler Maker, vol. 17, no. 7, July 1918, pp. 187-189, 2 figs. Arrangement of forms for recording calculations to order and lay out cone sheets for tapered portion of stack.

Classification

Power Plant Classification. A. P. Connor. Power Plant Eng., vol. 22, no. 14, July 15, 1918, pp. 566-568. Questionnaire of the Fuel Administration on power-plant equipment and operation. How to fill it out. The Administration's requirements.

Coal Handling

Problems in Coal Handling. W. B. Woodhouse. Elecn., vol. 81, no. 9, June 28, 1918, pp. 162-165, 4 figs. Variations in supply and demand; data regarding quantities for a 100,000-kw. plant; ground necessary for sidings; methods of handling coal and ashes.

Isolated Plants

Isolated Service for Economy. Power Plant Eng., vol. 22, no. 14, July 15, 1918, pp. 559-564, 8 figs. Description of the new condensing turbine plant of the Burroughs Adding Machine Co. at Detroit.

Piping

Determining the Heat Given Off by Engine and Power Piping. E. V. Hill and W. J. Mauer. Heat. & Vent. Mag., vol. 15, no. 7, July 1918, pp. 18-24, 9 figs. Data and results of tests made by the Ventilation Division of the Health Department of the City of Chicago.

Steam Pipe Explosions. Edward Ingham. Colliery Guardian, vol. 115, no. 3000, June 28, 1918, p. 1297, 4 figs. A theoretical investigation of the means for reducing steam-pipe explosions.

Underground Pipe Mains—Material, Depreciation, Sizes for Steam and Water. Charles L. Hubbard. Power, vol. 48, no. 3, July 16, 1918, pp. 80-83. Formulæ and tables for calculating pipe sizes, etc.

Steam Hydroelectric Plant

Galt Waterworks. W. F. Sutherland. Power House, vol. 11, no. 7, July 1918, pp. 195-197. Combined steam and hydroelectric pumping station on the Grand River south of the city of Galt.

See also Electrical Engineering (Electrolysis); Steam Engineering (Steam Traps).

PRODUCER GAS AND GAS PRODUCERS

"Gasteam" Plant at Ford City, Ontario. Power, vol. 48, no. 6, August 6, 1918, pp. 187-193, 13 figs. A combination alternating- and direct-current plant employing "Gasteam" engines; boiler feedwater to recover waste heat from gas-engine cylinder jackets; gas producer plant and its operating methods.

Generation of Suction Gas for Gas Engines. Chem. Eng. and Min. Rev., vol. 10, no. 118, July 1918, pp. 305-306. Results of an investigation made into the working conditions of two suction-gas units at a Bendigo mine, the engines of which developed the required horsepower when connected with charcoal generators, but were found to be deficient in power on being supplied from wood generators.

Practical Operation of a Producer-Gas Power Plant. Francisco R. Ycasimo and Felix V. Valencia. Philippine Jl. of Science, May 1918, vol. 13, no. 3, pp. 99-131, 9 figs. Discussion of tests on Philippine fuels and description of the suction producer-gas plant in the power house of the Bureau of Science, Manila.

PUMPS

Air Lift

Irrigating Florida Fruit by the Air Lift System. John Oliphant. Mine & Quarry, vol. 10, no. 47, July 1918, pp. 1064-1065.

Centrifugal Pumps

Modifying Centrifugal Pumps for Direct Motor Connection. B. B. Jackson. Eng. & Cement World, vol. 13, no. 2, July 15, 1918, pp. 70-73, 1 fig. Article explaining a given diagram of the characteristics of a 7-in. medium-head centrifugal pump when operated at five different speeds.

Piston and Plunger Pumps

Lift and Force Pumps. J. H. Perry. Domestic Eng., vol. 84, no. 6, August 10, 1918, pp. 144-196, 5 figs. Design, construction and operation of pumps of the piston and plunger types.

Rotary Feed Pumps

The Weir Turbine-Driven Rotary Feed Pump. Shipbuilding and Shipping Rec., vol 11, no. 25, June 20, 1918, pp. 683-684, 2 figs.

RAILROAD ENGINEERING, ELECTRIC

Armatures

Some Notes on Maintenance of Armatures. R. H. Parsons. Elec. Traction, vol. 14, no. 8, June 1918, pp. 330-333, 11 figs. Practical suggestions on the care of armatures on electric railways.

Braking, Regenerative

Regenerative Electric Braking on Locomotives of the C., M. & St. P. Ry. W. F. Coors. Ry. Rev., vol. 62, no. 24, June 15, 1918, pp. 867-869, 1 fig. Simplified wiring diagram of the direct-current regenerative braking scheme.

Circuit Breaker

High-Speed Circuit Breaker Prevents Flashover on Milwaukee Electrification. Elec. Ry. Jl., vol. 52, no. 4, July 27, 1918, pp. 154-156, 6 figs. Description of function and operation of a circuit breaker used by the Chicago, Milwaukee & St. Paul Ry., and said to avoid the energy waste resulting from the use of a permanent resistance.

Electrification

Electrification of the Philadelphia Chestnut Hill Section, Pa. R. R. Ry. Gaz., vol. 28, no. 26, June 28, 1918, pp. 756-759. Particulars relating to the electrification of a suburban line.

The Electrification of the Railroads of America (Un mot sur l'électrification des grands chemins de fer aux Etats-Unis d'Amerique). J. Cartier. Revue Générale de l'Electricité, vol. 3, no. 26, June 29, 1918, pp. 943-948. Account of the system of operation in use by the electrified roads of America and study of the reasons which decided in favor of their electrification.

Freight Handling

Freight Handling on the South Shore Lines. Elec. Traction, vol. 14, no. 8, June 1918, pp. 317-321, 4 figs. Features of singlephase electric-railway service between Chicago and South Bend, covering the Calumet industrial district.

Italian State Railways

Italian State Railways. Elec. Ry. & Tramway Jl., vol. 38, no. 924, June 14, 1918, pp. 219-220, 2 figs. Polyphase high-speed locomotives 2-C-2, group E 332, recently put into use by the Ateliers de Construction di Oerlikon.

Overhead and Track Work

A Graphical Method of Solving D. C. Track-Circuit Problems. H. M. Proud. Ry. Engr., vol. 39, no. 462, July 1918, pp. 141-145, 5 figs. Attempt to shorten calculations involved in the use of elaborate mathematical formulæ by using graphs in the solution of track problems. Paper presented before the Inst. of Ry. Signal Engrs. (To be continued.)

Electric Railway Construction on the Detroit-Superior Bridge. Elec. Ry. Jl., vol. 52, no. 4, July 27, 1918, pp. 145-146, 10 figs. Description of the overhead and track work.

The Maximum Regulating Resistance and Maximum Shunt Resistance of Track Circuits. W. J. Thorrowgood. Ry. Engr., vol. 39, no. 462, July 1918, pp. 140-141. Discussion of an original article published in the issues of May and June, 1918. Paper read before the Inst. of Ry. Signal Engrs.

Passenger Handling

Electric Railway Construction on the Detroit-Superior Bridge. Elec. Ry. Jl., vol. 52, no. 4, July 27, 1918, pp. 145-146, 3 figs. Track, power-supply system and provision for handling passengers on the concrete and steel bridge across the Cuyahoga River at Cleveland, Ohio.

Rail Joints

When Is a Rail Joint Well Bonded? G. H. McKelway. Elec. Ry. Jl., vol. 52, no. 3, July 20, 1918, pp. 111-112, 2 figs. The difference in the conductance of a bonded joint and that of the bond.

RAILROAD ENGINEERING, STEAM

Air Brakes

A 100-Car Test of the Automatic Straight Air Brake. Ry. Age, vol. 65, no. 4, July 26, 1918, pp. 173-176, 4 figs. Runs on Virginian Railway with 100 A. S. A. and combinations of 50 A. S. A. and 50 Westinghouse brakes.

Maintenance of Freight Brakes. T. H. Goodnow. Railroad Herald, vol. 22, no. 8, July 1918, pp. 170-171. Remarks made at a meeting of the Car Foreman's Assn. of Chicago.

Car Axles

Mine Car Axles. B. P. Lieberman. Coal Age, vol. 14, no. 5, August 1, 1918, pp. 219-222, 5 figs. **The suitability of iron and steel car axles; improvement of a steel axle of proper analysis by mechanical and heat treatment.**

Cross Ties

Standard Specifications for Cross Ties. Ry. Maintenance Engr., vol. 14, no. 8, August 1918, pp. 273-274. **Specifications adopted by the Central Advisory Purchasing Committee of the Railroad Administration.**

Feedwater Heaters

Feedwater Heaters. J. Snowden Bell. Ry. Rev., vol. 63, no. 1, July 6, 1918, pp. 14-16, 3 figs. Basic principles of construction of **feedwater heaters for locomotives. Read** before the Am. Master Mechanics' Assn.

Government Control

Railways, Waterways and Highways. Edward A. Bradford. Ry. Rev., vol. 62, no. 26, June 29, 1918, pp. 935-938, 4 figs. Discussion of the present conditions of Government control in the coöperation of waterways, railways and highways.

Locomotive Design

First of the U. S. Standard Locomotives Completed. Ry. Age, vol. 65, no. 3, July 19, 1918, pp. 131-133, 5 figs. Details and description of light Mikado type built by Baldwin Locomotive Works.

Methods of Valve Setting for Walschaert Gear as Used by Am. Loco. Co. J. J. Jones. Loco., vol. 9, no. 2, August 1918, pp. 385-388, 4 figs. Regulations of the Am. Loco. Co.

Mikado Type of Locomotive for United States Government. Ry. Rev., vol. 63, no. 3, July 20, 1918, pp. 87-88, 1 fig. Description of design said to fairly represent the best of conservative thought in American locomotive design.

Modern Locomotive Engine Design and Construction. M. I. and J. T. H. Ry. Engr., vol. 39, no. 462, July 1918, pp. 131-135, 3 figs. **Feedwater supply; locomotive feed**water heating systems. (Continuation of a serial.)

New Consolidation Locomotives and Excursion Cars on the Victorian Railways. Engineer, vol. 126, no. 3262, July 5, 1918, pp. 15-16, 5 figs.

Pacific and Mikado Type Locomotives. C., B. & Q. R. R. Ry. Rev., vol. 63, no. 1, July 6, 1918, pp. 1-5, 8 figs. Description of four types.

Recent Advances in Locomotive Efficiency. Paris, Lyons & Mediterranean Ry. Charles R. King. Ry. Rev., vol. 62, no. 24, June 15, 1918, pp. 851-855, 7 figs. The return to the use of compound locomotives with superheated steam after discovery that with improvements in design the superheater compounds are 35 per cent more efficient than the simples.

Locomotive Fuel

Anthracite Silt as a Locomotive Fuel. Ry. Rev., vol. 62, no. 24, June 15, 1918, pp. 857-860, 4 figs. Experiments made to adapt the silt mixture to locomotive use and the methods of preparation.

Lubrication

Coal Production and Lubrication. Reginald Trautschold. Coal Age, vol. 14, no. 4, July 25, 1918, pp. 175-176. Importance of lubrication of mine cars.

Railroad Operation

The Bearing of Malaria on Railroad Operation. H. W. Van Hovenberg. Ry. Age, vol. 65, no. 1, July 5, 1918, 2 figs. Descriptions of benefits to a road from a campaign to eliminate this sickness.

Roadbeds

Concrete Roadbed on Northern Pacific Ry. Eng. & Contracting, vol. 50, no. 3, July 17, 1918, pp. 55-56, 1 fig. Description of an experimental concrete roadbed with detail of construction.

Oil and Concrete-Reinforced Concrete in Railway Work. Ry. Age., vol. 39, no. 462, July 1918, pp. 135-137. Conditions under which oil may affect concrete. (Continuation of serial.)

Shocks in Trains

Shocks in Long Passenger Trains. R. **Burges. Railroad Herald, vol. 22, no. 8, July** 1918, pp. 172-175. Study of the factors that result in shocks. Review of a paper presented before the Southern and Southwestern Ry. Club.

Shops and Terminals

Buffalo Division Engine Terminals, Lehigh Valley R. R. Ry. Rev., vol. 62, no. 25, June 22, 1918, pp. 895-903, 25 figs. **Modernizing the entire Buffalo division. An illustrated** description of the important features.

Chilean Railroad Shops of American Design. Walter W. Nowak. Iron Age, vol. 102, no. 3, July 18, 1918, pp. 131-135, 3 figs. Plans won the $20,000 first prize from European engineers. A description of the shops.

New Shops and Engine Terminals, Buffalo, Rochester & Pittsburgh Ry. Ry. Rev., vol. 62, no. 25, June 22, 1918, pp. 907-911, 12 figs. Description of improved engine terminals and shop facilities, features of which are laid out for the requirements of Mallet compounds.

New York Central Opens Cleveland Freight Terminal. Ry. Age, vol. 65, no. 3, July 19, 1918, pp. 117-133, 11 figs. Description of the four-million dollar project.

Signal System

Position-Light Signals on Pennsylvania Railroad. Ry. Age, vol. 65, no. 4, July 26, 1918, pp. 177-178, 1 fig. **The extension of** the use of this type, its simplified aspects and reduction in costs of maintenance.

Train Operation by Signal Indication. Henry M. Sperry. Ry. Rev., vol. 63, no. 1, July 6, 1918, pp. 9-14, 6 figs. Features of the automatic block signal installation on **the Erie from New York to Chicago of interest** from a train-operation standpoint.

Train Operation by Signal Indication on the Erie. Henry M. Sperry. Ry. Age, vol. 65, no. 1, July 5, 1918, pp. 5-10, 6 figs. Some forms of train orders eliminated by use of power-operated train-order signals.

Stores

Railway Stores Methods and Problems. W. H. Jarvis. Ry. Gaz., vol. 28, no. 26, June 28, 1918, pp. 753-754; vol. 29, no. 1, July 5, 1918, pp. 9-12. Waste paper; tenders for scrap material; inspection of materials; standard patterns; standardization of materials. (Continuation of serial.)

Superheating

Installation and Maintenance of Superheater Dampers. Ry. Rev., vol. 62, no. 24, June 15, 1918, pp. 886-889, 6 figs. **Adapted** from Bul. No. 3 by the Locomotive Superheater Co.

Superheaters on Small Locomotives. Railroad Herald, vol. 22, no. 8, July 1918, p. 171. Dimensions of small locomotives built with superheaters by the Vulcan Iron Works, Wilkes-Barre, Pa.

Water Tanks

Creosoted Water Tanks. C. R. Knowles. Ry. Maintenance Engr., vol. 14, no. 8, August 1918, pp. 272-273.

See also Hoisting and Conveying (Loco Tractor).

REFRACTORIES

Silica Brick in Open-Hearth Furnace Roofs. Iron Age, vol. 102, no. 5, August 1, 1918, pp. 270-272. Deterioration as observed by French authorities; role of iron oxide and lime in their manufacture; composition after use in roofs. Translation abstracts made by E. C. Buck.

REFRIGERATION

Ammonia Solubility

The Solubility of Ammonia. M. J. Eichhorn. Ice & Refrigeration, vol. 55, no. 2, **August 1, 1918, pp. 41-47, 6 figs.** Formulae, tables, existing scientific data and review of researches concerning ammonia solutions in water.

Refrigeration, Electrical

The Opportunity of Electrical Refrigeration. H. N. Sessions. Jl. of Elec., vol. 41, no. 3, August 1, 1918, pp. 104-107. Possibilities of extension of electrical refrigeration.

RESEARCH

Industrial

Coöperation in Industrial Research. Iron Age, vol. 102, no. 3, July 18, 1918, pp. 140-144. A report of the topical discussion at the meeting of the Am. Soc. for Testing Materials, Atlantic City.

Organization of Industrial Research. Arthur D. Little. Eng. & Contracting, vol. 50, no. 4, July 24, 1918, pp. 90-91. New aspect of research; aims of research organization; research and technical schools; principles of general application in industrial-research laboratories.

Marine Engineering

Research in Marine Engineering. A. E. Seaton. Int. Mar. Eng., vol. 23, no. 7, July 1918, pp. 420-423. How lack of research has retarded progress in marine engineering; what it can accomplish. Paper read before the Inst. of Naval Architects, London, March 1918.

ROADS AND PAVEMENTS

Brick Pavements

The Bound Bases for Brick Pavements. John S. Crandell. Am. City, vol. 19, no. 2, August 1918, pp. 102-103. Suggested specifications for a tar-bound base for brick pavements. From an address before the Nat. Paving Brick Manufacturing Assn.

Concrete Pavements

Concrete Pavements. Murray A. Stewart. Can. Engr., vol. 35, no. 3, July 18, 1918, pp. 57-59. Recital of experimental work undertaken to ascertain the respective merits of different classes of concrete. Paper contributed to the 1917-1918 Trans. Am. Soc. of Mun. Improvements.

Construction of Concrete Pavements. J. L. Harrison. Eng. & Cement World, vol. 13, no. 13, August 1, 1918, pp. 27-29. Account of the behavior of a concrete road and general remarks regarding requirements of concrete for road use.

Costs

Ultimate Costs of Bituminous and Waterbound Macadams Nearly Equal in New York. Dudley P. Babcock. Eng. News-Rec., vol. 81, no. 2, July 11, 1918, pp. 87-90. Highway department investigation indicates that total tonnage affects cost but slightly; equation derived for the relation of ultimate cost to traffic tonnage.

Granite Paving Blocks

Granite Paving Block Industry. Stone, vol. 39, no. 7, July 1918, pp. 317-318. An account of the state of the industry throughout the country based on reports compiled under the direction of the U. S. Geological Survey.

Highways

Effect of Heavily Loaded Motor Trucks on Surfaced Highways. Western Eng., vol. 9, no. 8, August 1918, pp. 311-312. Discussion by several Eastern highway officials on the effect of motor-truck traffic on improved highways and of measures to be taken to protect such highways from deterioration. From the official magazine of the U. S. Office of Public Roads.

Problem of Highway Transportation. F. A. Seibarling. Eng. & Cement World, vol. 13, no. 2, July 15, 1918, pp. 23-26. Suggestions to adopt permanent construction on rural roads as a solution to the transportation problem.

Resurfacing

Who Pays for Resurfacing Pavements? Can. Engr., vol. 35, no. 4, July 25, 1918, pp. 83-86. Results of an investigation carried out by the Am. Soc. of Municipal Improvements regarding methods of securing and financing resurfacing of worn pavements followed by the principal cities of the United States and Canada.

Road Materials

Typical Specifications for Bituminous Road Materials. Bulletin No. 691 (60 pages), U. S. Department of Agriculture, July 10, 1918. Specifications offered by the Office of Public Roads and Rural Engineering and prepared partly from the results of its own experimental work.

Shrinkage of Road Materials

Determination of the Shrinkage of Gravel and Sand-Clay Mixtures Packed by Traffic. Roy M. Green. Good Roads, vol. 16, no. 5, August 3, 1918, pp. 39-40, 1 fig. Account of tests made and curve showing results obtained.

See also Engineering Materials (Road Materials).

SAFETY ENGINEERING

Electrical Accidents

Safeguarding the Home and Person from Electrical Accidents. Elec. Eng., vol. 52, no. 1, July 1918, pp. 25-36. Abstract from circular No. 75 of the U. S. Bureau of Standards setting forth the causes of electrical accidents.

Industrial-Plant Accidents

Reduction of Accident Hazard. R. L. Gould. Am. Mach., vol. 48, no. 25, June 20, 1918, pp. 1057-1060, 1 fig. A discussion of the questions confronting the safety engineer in his endeavor to minimize the risk of accident in our industrial plants and suggestions for promoting the work.

Mine Accidents

Protective Devices of Electrical Equipments in Mine Against Gases and Moisture (in Japanese). M. Furuta. Denki Gakkwai Zasshi, no. 355, February 1918, pp. 191-215.

Quarry-Operation Accidents

Accident Prevention in Quarry Operation. William H. Baker. Eng. & Contracting, vol. 50, no. 3, July 17, 1918, pp. 59-61. Abstract from an address delivered before the Nat. Safety Council.

Smelteries and Refineries

Safety Appliances in Smelteries and Refineries. George M. Douglass. Eng. & Min. Jl., vol. 106, no. 3, July 20, 1918, pp. 105-108, 8 figs. Devices used in a modern plant. Causes of common accidents and their prevention.

See also Electrical Engineering (Lightning Arrester; Transmission Lines).

SANITARY ENGINEERING

Carbon Dioxide in Air

The Safe Limit of Carbon Dioxide in the Working Atmosphere. G. O. Higley. Am. Jl. of Public Health, vol. 8, no. 7, July 1918, pp. 477-481.

Disinfectants

Report of the Committee on Standard Methods of Examining Disinfectants. Am. Jl. of Public Health, vol. 8, no. 7, July 1918, pp. 506-521.

Sewerage

An Inventory and Prospectus for a Comprehensive Sewerage System. H. W. Taylor. Am. City, vol. 19, no. 2, August 1918, pp. 139-143. A recent development in the city of Glens Falls, N. Y.

Sewage Treatment in Sedalia. Mun. Jl., vol. 45, no. 2, July 13, 1918, pp. 23-25, 3 figs. Missouri city employing grit chamber, Imhoff tanks, sludge beds, dosing tank and sprinkling filters to avoid polluting a small stream.

Uses and Accomplishments of Chlorine Compounds in Sanitary Science. Charles H. Jennings. Fire and Water Eng., vol. 64, no. 3, July 17, 1918, p. 44. Extract from a paper read by Mr. Jennings before the Southwestern Water Works Assn. at its convention in Tulsa, Okla.

Soap Solutions

On the Bactericidal Efficiency of Soap Solutions in Power Laundry. H. G. Elledge and W. E. McBride. Am. Jl. of Public Health, vol. 8, no. 7, July 1918, pp. 494-498.

Water

Analysis and Quality of Water. Mun. Jl., vol. 45, no. 4, July 27, 1918, p. 71. Table showing the results of the analyses of water made by several hundred municipal plants. (Concluded.)

Chemical and Bacteriological Examination of the London Waters. A. C. Houston. Can. Engr., vol. 35, no. 5, August 1, 1918, pp. 98-100. Report of the Metropolitan Water Board of London.

Water Purification. R. A. Collect. Indian Industries & Power, vol. 15, no. 9, May 1918, pp. 389-393, 2 figs. Extensive description of a Paterson filter plant, with an explanation of purifying process. (Concluded.)

See also Marine Engineering (Fumigating Apparatus).

STEAM ENGINEERING

Boiler Construction

Engineering Specialties for Boiler Making. The Boiler Maker, vol. 18, no. 7, July 1918, pp. 202-204, 6 figs. Description of new tools, machinery, appliances and supplies for the boiler shop and of improved fittings for boilers.

Method of Determining Row of Least Efficiency in Boiler Seams. D. Shirrell. Loco., vol. 9, no. 2, August 1918, pp. 366-368, 1 fig. Offered proof that the least efficiency—i.e., whether this least efficiency is in the outer row of rivets through the single welt or in the outer row of the double welt, depends upon the ratio between the thickness of the boiler shell plate and the diameter of the rivet.

Condensers

Getting a High Vacuum at the Turbine Exhaust. Hartley LeH. Smith. Elec. Ry. Jl., vol. 52, no. 3, July 20, 1918, pp. 99-101. Shows how faults in condenser design are being overcome and emphasizes some fundamental considerations.

Recent Developments in Condensers. D. W. R. Morgan. Elec. World, vol. 72, no. 5, August 3, 1918, pp. 204-206, 4 figs. Necessity of efficient air removal in surface condensers; relative advantages of steam air ejectors and hydraulic and reciprocating air pumps; increasing use of jet condensers for large units.

Steam Condensers. J. H. Coates. Nat. Eng., vol. 22, no. 8, August 1918, pp. 358-361, 1 fig. Reasons for selecting one of the two general types of condensers for a given service. Abstract of a paper read before the Iowa State Convention, N. A. S. E.

The Problem of Condensing in Large Power Stations. J. H. Rider. Elecn., vol. 81, no. 9, June 28, 1918, pp. 172-174. Emphasis laid on large quantities of water necessary in a plant of 200,000 kw. Methods which may be used when the flow of water on a river site is insufficient, with figures showing reduction in vacuum which results. The limitations of cooling towers for large power stations.

High-Pressure Steam

Possible Economies by the Use of High-Pressure Steam. Frederick Samuelson. Elecn., vol. 81, no. 9, June 28, 1918, pp. 166-168, 4 figs. Considers improved efficiency obtainable by increasing both the temperature and pressure of the steam. Emphasizes economy obtainable by using steam from turbines for heating feedwater. Particulars of high-pressure steam plant at the Rugby works of the British Thomson-Houston Co., Ltd.

Steam Plant Design—Care for High Pressures and Temperatures. Times Eng. Supp., no. 525, July 1918, p. 147. Possibility of obtaining higher overall efficiencies in large power stations by the use of steam at higher pressures and temperatures than have hitherto been usual. Paper read by Mr. J. H. Shaw before the Inst. of Elec. Engrs.

Reciprocating Engines

A Uniflow Engine Installation. Iron & Coal Trades Rev., vol. 97, no. 2629, July 19, 1918, p. 53, 2 figs. Description of two 500 hp. Robey uniflow steam engines.

Steam Engine Economy. D. Arnot. Practical Engr., vol. 57, no. 1635, June 27, 1918, pp. 304-305, 3 figs. Exposition of methods used and summary of results obtained in tests on several types of engines. (Concluded.)

Steam Traps

Some Notes on Steam Traps. Machy. Market, no. 925, July 26, 1918, pp. 19-20, 4 figs. Expansive traps so constructed that the amount of expansion is magnified in such a way that the trap itself can be made considerably smaller. (Continuation of a serial.)

Turbines

Discussion on the Stal-Turbine (in Japanese). Denki Gakkwai Zasshi, no. 355, February 1918, pp. 161-167.

Small Steam Turbines. J. Humphrey. Iron & Coal Trades Rev., vol. 97, no. 2629, July 19, 1918, p. 53, 2 figs. Comments on their use in mines.

Turbines Furnish Additional Power. Coal Industry, vol. 2, no. 8, August 1918, pp. 304-306, 1 fig. How the exhaust steam from a reciprocating engine may be utilized to furnish additional power through a turbine-generator unit.

Value of Stal-Turbine as Land Electric Generator (in Japanese). K. Koyama. Denki Gakkwai Zasshi, no. 355, February 1918, pp. 215-231.

2500 Hp. Rateau Marine Geared Turbines. Engineer, vol. 126, no. 3263, July 12, 1918, pp. 36-38, 8 figs. Illustrated description of turbines and gears.

See also Cooling; Engineering Materials (Boiler Plates); Marine Engineering (Boilers); Power Plants (Steam Hydroelectric Plant); Railroad Engineering, Steam (Superheating); Thermodynamics (Latent Heat of Steam).

STEEL AND IRON

Briquetting Ores

Present Knowledge and Practice in Briquetting Iron Ores. Guy Barrett and T. B. Rogerson. Automotive Eng., vol. 3, no. 6, July 1918, pp. 261-263. Methods followed and machines used in briquetting iron ores and diagrammatic sketches of several presses. (To be continued.)

Electrical Resistance in Steel

On the Thermal and Electric Conductivities of Nickel Steels. Kōtarō Houda. Science Reports of the Tōhoku Imperial Univ., vol. 7, no. 1, July 1918, pp. 59-66, 2 figs. Investigation of Wiedmann-Franz' law establishing that the ratio of the conductivities